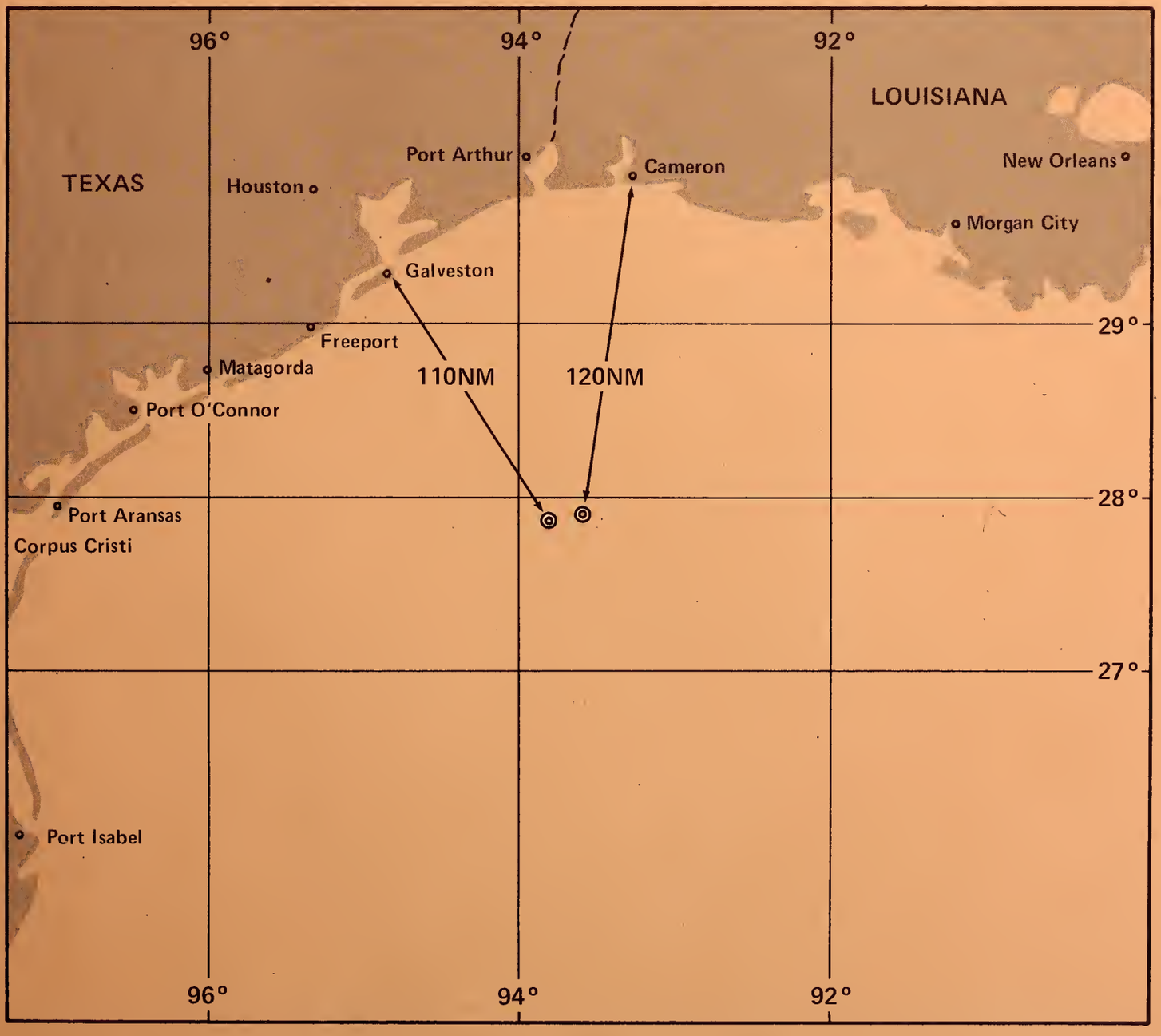
Draft Environmental Impact Statement Prepared on the Proposed East and West Flower Gardens Marine Sanctuary

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Office of Coastal Zone Management



DESIGNATION: Draft Environmental Impact Statement

TITLE: Draft Environmental Impact Statement on the Proposed Flower Garden Banks Marine Sanctuary

ABSTRACT: The proposal to designate the Flower Garden Banks as a marine sanctuary is an action under the Marine Protection, Research and Sanctuaries Act of 1972. The Banks, the East and West Flower Gardens, are the only two of many banks on the U.S. Continental Shelf in the Gulf of Mexico that contain coral reefs. Because the East and West Flower Garden Banks contain these unique biological communities and because they are threatened by oil and gas development, recreation, and commercial shipping activities, they have been identified as a candidate site for sanctuary status and protection. The site was considered for designation as a marine sanctuary in 1973, but the necessary agreements never were reached. Then in 1977, Texas State Senator A.R. Schwartz in conjunction with the Texas Coastal and Marine Council re-nominated the site for consideration as a sanctuary. This DEIS describes the environment at the site including the various other Federal authorities that apply. It also presents the proposed action, which is to proceed with designation of the site as a marine sanctuary, the preferred regulatory alternative for controlling activities at the site, and the other alternative regulations that were considered.

LEAD AGENCY: U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Office of Coastal Zone Management
Sanctuary Programs Office

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Sanctuary Programs Office
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COMMENTS: Comments must be received at the above address by _____.

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NOTE TO THE READER

The two major segments of this DEIS are Section E, the Description of the Affected Environment, which presents a review of the environment at the Flower Garden Banks, including the natural resources and the human activities, and Section F, the Environmental Consequences and Alternatives, which discusses a no action or status quo alternative, the perferred alternative of designating a marine sanctuary and establishing regulations of certain activities, and alternative regulatory provisions, and which discusses the effect each alternative could have on the biological and economic environment. The proposed action in this DEIS, labeled the Preferred Alternative, is compared to the other alternatives in Section F. Certain additional documentation and a list of references are appended for those who wish to explore any aspect in greater detail. Particular attention should be paid to the draft Designation document and the draft proposed regulations which follow immediately after the summary.

All persons are alerted to publication of the regulations in proposed form in the Federal Register. Comments on the regulations may be submitted in writing to:

Director, Sanctuary Programs Office
Office of Coastal Zone Management
National Oceanic and Atmospheric Administration
Washington, D.C. 20235

Public hearings on this DEIS and any other aspect of the proposed designation of the Flower Garden Banks Marine Sanctuary will be held in Galveston, Texas, and in Lake Charles, Louisiana. All those with an interest in the proposed designation are invited to attend and

present their views. Those who cannot attend may send their comments to the address above. Written comments will receive the same consideration as oral testimony.

After review of all comments, NOAA will decide whether to proceed with the designation. If NOAA proceeds, the agency will issue a final EIS, seek Presidential approval of the designation, and publish final regulations in the Federal Register.

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SUMMARY

Introduction

The Marine Protection, Research and Sanctuaries Act of 1972 (Public Law 92-532) authorizes the Secretary of Commerce with Presidential approval to designate ocean areas with distinctive conservation, recreational, ecological, or aesthetic values as marine sanctuaries. The Flower Garden Banks, lying more than one hundred miles offshore Texas and Louisiana in the Gulf of Mexico, have been nominated as a candidate site for marine sanctuary designation by Texas State Senator A. R. Schwartz in conjunction with the Texas Coastal and Marine Council. The Banks are biologically unique and important. They contain the northwestern most living coral reefs on the Gulf of Mexico Outer Continental Shelf, and are, thus, the only truly tropical coral reefs in the northwestern Gulf. The live reef contains 18 coral species, more than 100 species of caribbean reef fish, and more than 200 invertebrate species.

For more than a year The Office of Coastal Zone Management (OCZM), of the National Oceanic and Atmospheric Administration (NOAA), in the Department of Commerce has been studying the Banks and the proposal to designate the area as a marine sanctuary. In order to determine the desirability and feasibility of proceeding with the designation, NOAA has gathered and analyzed information and consulted with other Federal agencies, State governments and local interest groups. A White Paper

outlining a tentative proposal for public review was prepared and issued in June 1978. Based on public responses to the White Paper and the input of many interested parties, NOAA proceeded with this environmental assessment in accordance with the National Environmental Policy Act of 1969 (NEPA).

NOAA's environmental assessment provides the basis for this draft environmental impact statement (DEIS) which describes the proposed action to designate the sanctuary including draft regulations on activities and uses. Within NOAA, the Office of Coastal Zone Management (OCZM) has lead agency responsibility for administration and implementation of the marine sanctuary program. OCZM has reviewed numerous options for both designation and presents the proposed action described in this DEIS as the preferred alternative. (See Chapter F.)

The preferred alternative does not represent a final decision; it is presented and evaluated in this DEIS for public review. NOAA will receive comments on this DEIS, hold public hearings in Galveston, Texas, and Lake Charles, Louisiana, and respond to all comments received. After review of comments and final consultation with Federal agencies, if a decision is made to proceed with the designation, NOAA must seek Presidential approval of the proposed marine sanctuary designation.

A draft Designation document and a set of draft proposed regulations appear at the end of this summary. These documents describe the preferred alternative and will be published in identical form in the FEDERAL REGISTER

concurrently with the distribution of this DEIS. The comment period will be open for sixty days after which, if a sanctuary is to be designated, final regulations will be published in the FEDERAL REGISTER including responses to comments received.

Proposal To Designate the Flower Garden Banks Marine Sanctuary

The Office of Coastal Zone Management proposes to designate the Flower Garden Banks as a marine sanctuary and to manage the area through a set of regulations. The sanctuary proposed includes an area in the Gulf of Mexico located approximately 110 nautical miles (nm) southeast of Galveston, Texas, and 120 nm south of Cameron, Louisiana.

The area proposed for sanctuary designation includes the waters over the following:

East Flower Garden Bank, the topographic structure in the Gulf of Mexico with approximate center point of 27° 55' 07.44" N and 93° 36'08.49"W.

West Flower Garden Bank, the topographic structure in the Gulf of Mexico with approximate center point at 27° 52' 14.21" N and 93° 48' 54.79" W.

The proposed area of the Flower Garden Banks Marine Sanctuary is the space enclosed by a continuous line four nautical miles from the 100-meter isobaths of each Bank except that the boundary has been modified not to intrude on the shipping safety fairway south of the West Flower Garden Bank. (See Figure C-1). The exact boundary by coordinates is presented following this summary in Appendix B to the proposed regulations. For navigation and most other purposes this boundary can be approximated by circular arcs at all points four nautical miles from the 50 fathom (100 meter; 330 feet) isobath except south of the West Flower Garden Bank where the circular boundary is truncated by the Gulf Shipping Safety Fairway which runs in an east-west direction approximately six miles from the Bank's mid-point.

The sanctuary will include an area of about 175 square nautical miles. The proposed sanctuary boundary reflects the size of the area within which regulation is necessary to protect the resources of the Banks.

Designation

A Designation document, the draft of which is presented after this summary, will establish the boundary of the sanctuary, the purposes of the sanctuary, identify the types of activities that may be subject to regulation under the Marine Sanctuaries Act, and specify the extent to which other regulatory programs will continue to be effective within the sanctuary. The Designation requires the approval of the President. Its

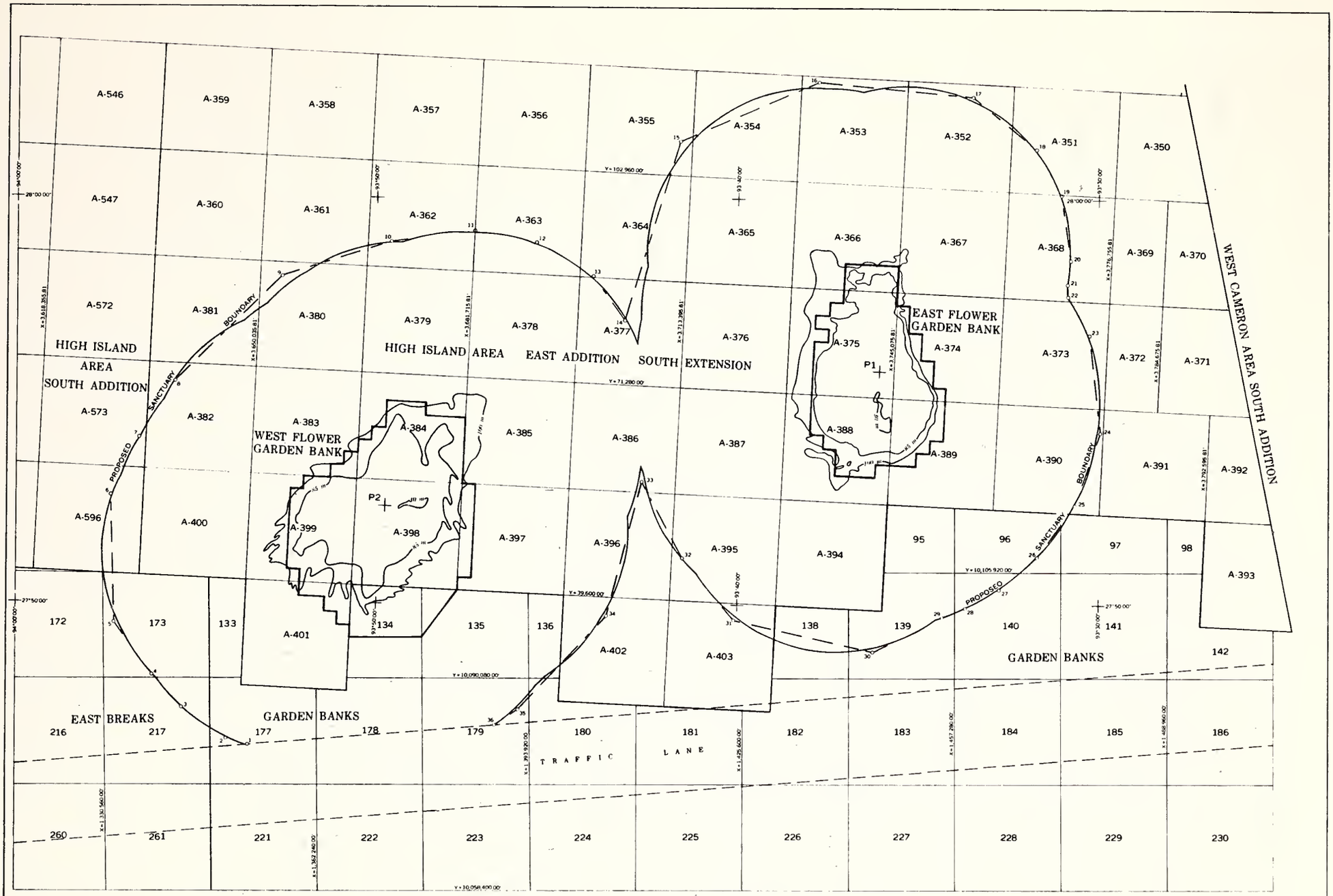


Figure C-1. Proposed boundary of the Flower Garden Banks Marine Sanctuary.

EAST AND WEST FLOWER GARDEN BANK AREAS
PROTECTIVE RESTRICTIONS BOUNDARIES
SCALE 1" = 1000'

content can be altered only after repeating the entire designation process and securing Presidential approval.

The Designation presented in this DEIS identifies the proposed sanctuary as the area within 4 nautical miles of the 100-meter isobath around each bank and also identifies the following activities as subject to regulation:

- deliberate damage or harm to corals and marine invertebrates;
- operations of vessels other than fishing vessels and anchoring by all vessels;
- dredging or altering the sea bed;
- construction;
- discharging or depositing any substance;
- using poisons, explosives, electric charges or spearguns;
- trawling within the 100 m isobaths of the Banks; and
- oil and gas operations.

Regulations have been considered for all of these activities; however, in some cases, such as spearfishing and vessel navigation, no regulations are proposed at this time. By listing these activities in the Designation, NOAA reserves the ability to propose regulation of these activities in the future, without obtaining Presidential approval of an amendment, if threats to the resources increase.

Management

Management of the Marine Sanctuary will be designed to preserve the coral reef and other bank ecosystems in their natural state. By integrating education, environmental monitoring, and compatible use regulations into a coordinated management strategy, NOAA will insure that the public can derive maximum benefit from the Marine Sanctuary with a minimum of environmental damage. A detailed management plan will be developed following designation of the sanctuary.

Enforcement and surveillance will be an integral part of the management and protection of the Flower Garden Banks. NOAA is exploring various means of providing enforcement and surveillance. The participation of any enforcement agent will be the subject of continuing discussions and will be affected by the precise scope and content of the final regulations, as well as by other demands and priorities facing NOAA and the other agencies involved.

Proposed Regulations

In this DEIS, NOAA presents, reviews and analyzes the environmental and economic impacts of a preferred alternative marine sanctuary designation with certain boundaries and certain regulations. These regulations will apply within the sanctuary boundaries and will implement the terms of the Designation. Only if an activity is listed in the Designation will it be subject to regulation. If an activity is listed and not regulated, such as

spearfishing and vessel navigation, NOAA has determined that while the activity has the significant potential to harm the resources of the Flower Garden Banks, no immediate restriction is appropriate because certain data are unavailable or because NOAA believes coordination with other agencies or other non-regulatory approaches should be attempted first.

The preferred alternative, presented in detail in Section F and summarized here, includes a set of regulations dealing with the activities listed in the Designation. The exact text of the proposed regulations as they will appear in the FEDERAL REGISTER is presented following this summary.

The regulations proposed in the preferred alternative include the following controls:

° Taking, disturbance, or harm to corals and marine invertebrates.

The major purpose for designation of the sanctuary is protection of the ecosystems of the Flower Garden Banks, particularly their unique coral reef caps. Accordingly, the proposed regulation prohibits taking, disturbing or harming corals and other marine invertebrates. All corals, living and non-living will be protected. The only items not subject to this regulation are the shells of dead invertebrates.

° Operation of vessels other than fishing vessels and anchoring of all vessels.

The anchoring regulations address both commercial and recreational boat anchoring. Under the regulations, commercial ships and oil industry supply vessels will be prohibited from anchoring within the 100 m isobaths of the Banks. This prohibition will protect the reefs and their ecosystems from the severe physical impacts caused by anchoring.

Anchoring by commercial vessels will be prohibited to the extent consistent with international law. Anchoring by recreation boats and recreational charter boats will be allowed, but anchoring on corals or coral heads or in such a manner as to damage any coral formation is to be avoided. For dive boat operations, the first divers down will inspect the anchor to insure it is properly set before diving can continue. These anchoring regulations will ensure that there is no direct anchor damage to corals and will prevent chains, wires, and shifting anchors from abrading the reefs.

° Dredging or altering the sea bed.

° Construction.

No dredging or other alteration of the seabed is allowed within the 100 m isobath. Pipeline placement, platform placement, construction or mooring of construction equipment will not be allowed within this zone. This prohibition will insure that no mechanical damage is done to any of the biologic zones at the Banks including the crinoid zone which occurs at the 100 m isobath.

° Discharging or depositing any substance.

With the exception of regulated discharges of drilling muds and cuttings specified below, any discharge in the sanctuary, including oily waste, will be prohibited. Further exceptions are granted for effluents from marine sanitation devices, cooling water effluents from ocean vessels, fish cleaning wastes, and chumming materials. Discharges from vessels within the sanctuary will be prohibited to the extent consistent with international law.

° Use of poisons, explosives, electric charges or spearguns.

The use of poisons, explosives, and electric charges would be inconsistent with the purposes of the sanctuary and the proposal prohibits their use. While the present level of spearfishing at the Banks does not appear to be affecting the biological resources, the lack of definite evidence on this point and the possibility of increases in the activity resulting in harm have prompted inclusion of spearfishing as an activity that may be subject to regulation in the future. Study of spearfishing in heavily used areas, such as the Key Largo Marine Sanctuary, has revealed that it causes some alteration of the ecosystem. If the level of spearfishing increases rapidly at the Flower Garden Banks, NOAA will be able to respond by proposing regulations, authorized under the terms of the Designation.

° Trawling within the 100 m isobaths of the Banks.

Regulation of both commercial and recreational fishing in the waters proposed for designation of the Flower Garden Banks Marine Sanctuary is the responsibility of the Gulf of Mexico Regional Fishery Management Council and the National Marine Fisheries Service pursuant to the Fishery Conservation and Management Act of 1976 (P.L. 94-265). No additional regulation by OCZM except a prohibition on bottom trawling within the 100-meter isobath is being proposed under the preferred alternative. Bottom trawling could be devastating to the coral reefs and is therefore prohibited.

° Oil and gas operations.

Oil and gas activities would be regulated in several specific ways.

For leases awarded prior to the effective date of the regulations, the following controls will apply:

-- A no-activity zone will be established which includes the area defined as a no-activity zone under the BLM stipulation (see Appendix A to the regulations) plus the area outside the BLM zone but inside the 100 m isobaths of the Banks. Within the no-activity zone drilling, dredging, mooring, construction, platform placement or any other like activity will be prohibited. The regulation is necessary for the protection of the coral reefs and hard bank biological communities.

-- Within the sanctuary boundary, which is 4 nautical miles from the 100 m isobaths, and outside the no-activity zone:

- ° Surface discharges of drill cuttings and adherent muds will be prohibited and shunting these materials to within 6-meters of the bottom will be required. This will provide some assurance that these materials will be deposited in the nepheloid layer;
- ° Monitoring of these discharges will be required once before, frequently during and once after drilling. Because experience with drilling near the Banks is limited and because scientific questions still remain about the effects of drilling muds on marine organisms, monitoring is necessary to insure that allowable discharges are not affecting the reefs;
- ° Discharges of drilling muds in bulk will be prohibited. This will insure that large amounts of muds are not released to the environment in a short time; and
- ° The simultaneous discharge of effluents from more than one well on a single rig or platform will be prohibited. Like the prohibition on bulk discharging, this regulation will prevent concentrated release of volumes of sediment to the environment.

In addition to these specific regulations dealing with individual drilling activities, the regulations will also require that the operator possess a valid and final National Pollutant Discharge Elimination System (NPDES) permit from the Environmental Protection Agency and any and all other permits that may be required by other Federal agencies.

-- A moratorium will be placed on all oil and gas activities on leases awarded after the effective date of the regulations. The moratorium will have a duration of 5 years from this date, during which time environmental studies performed by NOAA, EPA, other Federal agencies and the oil

and gas industry under a monitoring program will help resolve unanswered questions concerning the effects of oil and gas development on the reef ecosystem. At the conclusion of this 5-year period the need for restrictions of oil and gas operations to preserve the reef will be reassessed.

Environmental Consequences of the Proposed Action

Designation of the Flower Garden Banks Marine Sanctuary and implementation of the proposed regulatory framework will benefit the biological resources of the Banks and will affect the socio-economic environment of the area. The environmental consequences of the designation, as well as the environmental consequences of other alternatives that were considered, are presented in Part F. The additional costs upon those ocean users affected by the regulations also are discussed in Part F as part of the environmental analysis.

The environmental and socio-economic consequences can be summarized as follows:

° Environmental protection. Sanctuary designation will afford a higher level of protection to the Banks' ecosystems than currently exists under other Federal authorities. Protection of corals from anchoring, trawling and other physical damage will be provided where no such protection now exists. Discharges of oily and other wastes from vessels, within the limitations of international law, will be prohibited, providing greater protection than presently.
Oil and gas operations will be subject to stricter controls than those currently in place. Additional protection is provided by prohibiting use of poisons, electric charges, and explosives which could be devastating to the ecosystems.

° Inconvenience to recreational users. Some recreationists will be slightly inconvenienced because they will be required to follow proper anchoring procedures .

° Inconvenience to commercial vessel traffic. Some commerical vessels may be slightly inconvenienced since they cannot discharge any waste materials within the sanctuary.

° Inconvenience to commercial fishermen. Since it has been determined that bottom trawling is not now a practice at the Banks, it is doubtful that the prohibition on bottom trawling within the no-activity zone will cause any impacts to fishermen.

° Additional costs to oil and gas operators. The proposed action will impose some costs on oil and gas operators. The five-year moratorium on oil and gas activities seems likely to render future proposed oil and gas leases within the sanctuary undesirable to prospective bidders. This does not represent an irreversible or irretrievable loss, however, since the resource will be available if, and when the moratorium is eventually lifted and the capital which would have been invested can be productively employed in other leases in the interim period. The BLM presently requires shunting on some tracts within the proposed sanctuary, although not to the depth proposed in the regulations. The sanctuary shunting requirement will add slight additional costs to those operations already subject to the BLM shunting requirement. It will add approximately $50,000 to $82,000 per platform to the costs of those operators which are not now required to shunt. The monitoring requirement will add $300,000 to $500,000 per well to

the cost of drilling in those areas where monitoring is not now required by BLM, i.e., outside a line 1 nm from the 85-meter isobath and within the sanctuary. This is the single largest expense to be incurred as a result of the designation of the sanctuary. The prohibitions on bulk discharges and simultaneous discharges from more than one well from a rig or platform are expected to add only minor costs to operations. It is normal industry practice, for instance, to drill one well at a time from a single rig. Many of these expenses might have been incurred in compliance with the NPDES and other Federal agency permit conditions which must be obtained regardless of whether the area is designated a marine sanctuary. Thus, these are maximum cost estimates.

The overall environmental effect of sanctuary designation should be protection of the unique reefal communities with minimum interference to users of the Banks. As mentioned, a detailed treatment of environmental and economic consequences is presented in Part F.

Marine Sanctuary Permits

Marine sanctuary permits, issued by NOAA, will be required for any activity which would otherwise violate the regulations and may be granted only if the activity will serve research or educational purposes or is related to salvage operations. The permit procedure is specified in the regulations.

Certification of Other Permits

The regulations propose to certify in advance any permit, license or other authorization to act within the sanctuary as long as the activity does not violate marine sanctuary regulations. This notice of validity avoids duplicating permit delays and costs where there is no violation.

NOAA-EPA Agreement

NOAA and EPA, which has authority under the Federal Water Pollution Control Act to regulate discharges in ocean waters, have reached an agreement dealing with discharges from oil and gas operations. Under this agreement the NPDES permit conditions and the proposed sanctuary regulations will correspond to the maximum extent practicable.

In addition to the correspondence of sanctuary regulations and NPDES permit conditions, EPA will issue no NPDES permits for discharges from operations in any lease awarded after the effective date of the marine sanctuary regulations. This moratorium will correspond to the NOAA proposed moratorium on all oil and gas activity within the sanctuary in any lease awarded after that date.

Additionally, NOAA and EPA have agreed to pursue development and implementation of a research and monitoring program during the moratorium period. This program will focus on determining the effects of oil and gas operations on the Flower Garden Banks' ecosystems to insure that the marine sanctuary regulations and the NPDES permit conditions are properly attuned to environmental protection needs. At the conclusion

of the five year moratorium, the extent and scope of regulation of oil and gas operations will be reassessed and modified regulations will be proposed as needed.

Alternatives to the Proposed Action

The alternative regulations which were considered in addition to the proposed regulations are presented in Part F.

Text of the DEIS

The proposed Designation and regulations, with appendices, appear immediately after this summary, followed by the full environmental impact analysis.

TITLE 15 - COMMERCE AND FOREIGN TRADE

CHAPTER IX - NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

PART 934 - FLOWER GARDEN BANKS MARINE SANCTUARY

AGENCY: National Oceanic and Atmospheric Administration (NOAA), Department of Commerce

ACTION: Proposed Rule

SUMMARY: These regulations define permissible activities within the Flower Garden Banks Marine Sanctuary, the procedures by which persons may obtain permits for prohibited activities, and the penalties for committing prohibited acts without a permit.

DATE: Comments due 60 days after publication in the Federal Register

ADDRESS: Send Comments to: Director, Sanctuary Programs Office, Office of Coastal Zone Management, NOAA, 3300 Whitehaven Street, N.W., Washington, D.C. 20235.

PERSON TO CONTACT FOR FURTHER INFORMATION: JoAnn Chandler, Acting Director, Sanctuary Programs Office, Office of Coastal Zone Management, NOAA, 3300 Whitehaven St. N.W., Washington, D.C. 20235. 202-634-4236.

SUPPLEMENTARY INFORMATION:

Title III of the Marine Protection, Research, and Sanctuaries Act of 1972, 16 U.S.C. 1431-1434 (the Act) authorizes the Secretary of Commerce, with Presidential approval, to designate ocean waters as far seaward as the outer edge of the Continental Shelf as marine sanctuaries to preserve or restore distinctive conservation, recreational,

ecological, or aesthetic values. Section 302(f) of the Act directs the Secretary to issue necessary and reasonable regulations to control any activities permitted within a designated marine sanctuary. The authority of the Secretary to administer the provisions of the Act has been delegated to the Assistant Administrator for Coastal Zone Management within the National Oceanic and Atmospheric Administration, U.S. Department of Commerce (the Assistant Administrator).

The Office of Coastal Zone Management is proposing to designate as a marine sanctuary an area of the Gulf of Mexico known as the East and West Flower Garden Banks located approximately 110 nautical miles (nm) southeast of Galveston, Texas and 120 nm south of Cameron, Louisana. The proposed sanctuary would include the waters overlaying the banks and extending to within 4 nm of the 100 m (328 ft.) isobaths of each bank, a total area of approximately 173.25 square nautical miles.

The Banks are biologically unique and important. They contain the northernmost living coral reefs on the U.S. Continental Shelf, the only truly tropical coral reefs in the northwestern Gulf of Mexico. The live banks contain some 18 coral species; the ecosystem supports more than 100 species of caribbean reef fish and more than 200 species of invertebrates.

Since the nomination of the Banks as a Sanctuary, over a year ago, NOAA has been studying the Banks and the proposal to determine the desirability and feasibility of designation. After gathering and analyzing information and consulting with other Federal agencies, the Gulf Regional Fishery Management Council, State and local governments

and interest groups, a White Paper was prepared and issued in June 1978 outlining a tentative proposal for public review. Based on the responses to this White Paper, NOAA prepared a draft environmental impact (DEIS) which is being published concurrently with these regulations. (A copy can be obtained by writing to the contact identified above).

The rationale for designation and for the proposed regulatory system as well as alternative approaches, both regulatory and non-regulatory are more fully set forth in the DEIS. OCZM will receive public comments on the proposal, hold public hearings in Galveston, Texas, and Lake Charles, Louisana and prepare a final EIS and regulations which incorporate and respond to these comments received. Only after final consultation with Federal agencies, and with Presidential approval, can the Secretary designate the sanctuary and promulgate the regulations.

NOAA policy and its proposed General Marine Sanctuary Regulations (44 FR 6930) provide that the regulatory system for a marine sanctuary will be established by two documents, a Designation document and the regulations issued pursuant to Section 302(f) of the Act.

The Designation will serve as a constitution for the sanctuary, establishing among other things the purposes of the sanctuary, the types of activities that may be subject to regulation within it and the extent to which other regulatory programs will continue to be effective. As proposed, the Flower Gardens Designation document would provide as follows:

Draft Designation Document

Designation Of The Flower Garden Banks Marine Sanctuary

Preamble

Under the authority of the Marine Protection, Research and Sanctuaries Act of 1972, P.L. 92-532, (the Act) the Flower Garden Banks are hereby designated a Marine Sanctuary for the purposes of preserving and protecting this unique and fragile ecological community.

Article 1. Effect of Designation

Within the area designated as the Flower Garden Banks Marine Sanctuary (the Sanctuary), described in Article 2, the Act authorizes the promulgation of such regulations as are reasonable and necessary to protect the values of the Sanctuary. Article 4 of the Designation lists those activities which may require regulation but the listing of any activity does not by itself prohibit or restrict it. Restrictions or prohibitions may be accomplished only through regulation and additional activities may be regulated only by amending Article 4.

Article 2. Description of the Area

The Sanctuary consists of an area of the Gulf of Mexico of 173.25 square nautical mile (nm2) located approximately 110 nm southeast of Galveston, Texas, and 120 nm south of Cameron, Louisiana, overlaying the East and West Flower Garden Banks, the approximate midpoints of which are respectively, 27°55'07.44"N; 93°36'08.49"W. and 27°52'14.21"N; 93°48'54.79"W and extending to the waters within 4 nm of the 100 m. (328 ft.) isobaths surrounding the Banks. The precise boundaries are defined by regulation.

Article 3. Characteristics of the Area That Give it Particular Value

The Flower Garden Banks contain the northwestern most coral reef ecosystems in the Gulf of Mexico with hundreds of species of marine organisms, including at least 18 species of Caribbean corals and diverse tropical faunal and floral communities. The Banks provide exceptional recreational experiences and scientific research opportunities and generally have unique value as an ecological, recreational, and esthetic resource.

Article 4. Scope of Regulation

Section 1. Activities Subject to Regulation. In order to protect the distinctive values of the Flower Garden Banks, the following activities may be regulated within the Sanctuary to the extent necessary to ensure the protection and preservation of the coral and other marine features and the ecological, recreational, and esthetic value of the area:

a. Removing, breaking or otherwise deliberately harming coral, bottom formations or marine invertebrates or plants, or taking tropical fish, except incidentally to other fishing operations.

b. Operations of vessels other than fishing vessels, including anchoring and navigation, and anchoring by fishing vessels.

d. Dredging, or altering the seabed in any manner.

d. Construction

e. Discharging or depositing any substance or object.

f. Using poisons, electric charges, spearguns or explosives.

g. Trawling or dragging bottom gear within the 100 m (328 ft.) isobaths.

Section 2. Consistency with International Law. The regulations governing the activities listed in Section 4 of this Article will be applied to foreign flag vessels and persons not citizens of the United States only to the extent consistent with recognized principles of international law or as otherwise authorized by international agreement.

Section 3 Emergency Regulations. Where essential to prevent immediate, serious and irreversible damage to the ecosystem of the Banks, activities other than those listed in Section 1 may be regulated within the limits of the Act on an emergency basis for an interim period not to exceed 120 days, during which an appropriate amendment of this Article would be proposed in accordance with the procedures specified in Article 6.

Article 5. Relation to Other Regulatory Programs

Section 1. Fishing. The regulation of fishing is not authorized under Article 4 except with respect to the removal or deliberate damage of distinctive features (paragraph (a)), the use of certain techniques (paragraph (f)), or trawling on the banks (paragraph (g)). In addition, fishing vessels may be regulated with respect to discharges (paragraph (e)) and anchoring (paragraph (b)). All regulatory programs pertaining to fishing, including particularly Fishery Management Plans promulgated under the Fishery Conservation and Management Act of 1976, 16 U.S.C. 1801 et seq. shall remain in effect and all permits, licenses and other authorizations issued pursuant thereto shall be valid within the Sanctuary unless inconsistent with any regulation implementing Article 4.

Section 2. Defense Activities. The regulation of those activities listed in Article 4 shall not prohibit any activity conducted by the Department of Defense that is essential for national defense in times of war or other national emergency. Such activities shall be conducted consistently with such regulation to the maximum extent practicable. All other activities of the Department of Defense are subject to Article 4.

Section 3. Other Programs. All applicable regulatory programs shall remain in effect and all permits, licenses and other authorizations issued pursuant thereto shall be valid within the Sanctuary unless inconsistent with any regulation implementing Article 4. The Sanctuary regulations shall set forth any necessary certification procedures.

Article 6. Alterations to this Designation

This Designation can be altered only in accordance with the same procedures by which it has been made, including public hearings, consultation with interested Federal and State agencies and the Gulf of Mexico Regional Fishery Management Council, and approval by the President of the United States.

Only those activities listed in Article 4 are subject to regulation in the Sanctuary. Before any additional activities may be regulated, the Designation must be amended through the entire designation procedure including public hearing and approval by the President. However, no additional regulation is proposed for two listed activities, spearfishing and navigation, at this time because, despite the potential threat, the need for additional control is not established.

The primary purpose of the proposed regulations is to protect and to preserve the natural state of the banks' ecosystems, particularly the unique coral reefs capping the banks. Accordingly, all activities which would directly destroy or injure corals and other distinctive marine features are prohibited. Such activities include any type of handling, picking or collecting (sec. 934.6(a)(1)), anchoring within the 100 m isobaths except by certain vessels (sec 934.6(a)(2)) and construction or other alterations of the seabed within the 100 m isobaths. (Sec. 934.6(a)(3)). To reduce the possibility of damage to the resources by pollution, all discharges are prohibited except for marine sanitation

effluents, vessel cooling waters, fish cleaning wastes and chumming materials, and discharges incidental to certain hydrocarbon operations. (sec. 934.6(a)(5)). All prohibitions must be applied consistently with recognized principles of international law.

All hydrocarbon operations are prohibited within the particularly important hard bank areas to protect the various components of the reef ecosystem. This no activity zone includes primarily the area where such such activities are already prohibited by BLM (within the 85 m isobaths as defined by the quarter-quarter-quarter system (see Appendix A)) but extends to the 100 m isobaths where they are further from the Banks' midpoints. In this area, drilling operations would destroy or injure coral either directly or by pollution.

In the remainder of the sanctuary, hydrocarbon operations under existing leases may continue subject to conditions imposed by other authorities and those conditions designed to minimize pollution listed in sec. 934.7(b) which include requirements that cuttings and adhering drilling muds be shunted to within 6 m of the bottom and that the effects of operations on the banks be monitored. The Environmental Protection Agency (EPA) and NOAA have agreed that these proposed regulations and the conditions of EPA's permits issued under section 402 of the Federal Water Pollution Control Act, 33 U.S.C. 1431, (known as NPDES permits) will correspond to the maximum extent practicable. The appropriate monitoring program will be established in cooperation with the EPA and the precise requirements for any operator established as conditions of its NPDES permits. The conditions of these NPDES permits will also

establish the clean up capacity required of any operator. The arrangement between EPA and NOAA is set forth in the Principles of Agreement dated March 13, 1979, Appendix C.

No hydrocarbon exploration and exploitation under leases issued after the effective date of these regulations will be allowed within the Sanctuary for a period of five years to provide an adequate period for the monitoring program to evaluate the effects of operations on the banks.

With limited exceptions, fishing in the waters proposed for the Sanctuary will have not any detrimental effect on the resources of the Sanctuary and its regulation remains the responsibility of the Gulf of Mexico Regional Fishery Management Council and the National Marine Fishery Service pursuant to the Fishery Conservation and Management Act of 1976, 16 U.S.C 1801 et seq. except as specifically set forth in the Designation. (See Article 5, Section 1 of the Designation.) No additional regulation has been proposed by OCZM except for the prohibitition of bottom trawling in the sensitive hard banks area, within the 100m isobaths, (Sec. 934.6(a)(4)), and the taking of coral or tropical fish (Sec. 934.6(a)(1)). Fishing vessels are subject to discharge and anchoring regulations (Sec. 934.6(a)(2) and (a)(5)).

Accordingly, Part 934 is proposed as follows:

PART 934 - FLOWER GARDEN BANKS MARINE SANCTUARY REGULATIONS

Sec.

934.1 Authority.

934.2 Purpose.

934.1. Authority.

The Sanctuary has been designated by the Secretary of Commerce pursuant to the authority of section 302(a) of Title III of the Marine Protection, Research and Sanctuaries Act of 1972, 16 U.S.C. 1431-1434 (the Act). The following regulations are issued pursuant to the authorities of sections 302(f), 302(g) and 303 of the Act.

934.2. Purpose.

The purpose of designating the East and West Flower Garden Banks as a Marine Sanctuary is to protect and preserve the banks ecosystems in their natural state and to regulate uses within the Sanctuary to insure the health and well-being of the coral and associated flora and fauna and the continued availability of the area as a recreational and research resource.

934.3. Boundaries.

The Sanctuary consists of an area of the Gulf of Mexico located approximately 110 nautical miles (nm) south east of Galveston, Texas, and

120 nm south of Cameron, Louisiana overlaying and surrounding those banks known as the East and West Flower Garden Banks to a distance of 4 nm from the 100 m isobath of each Bank. The coordinates are in Appendix B.

934.4. Definitions.

(a) "Administrator" means the Administrator of the National Oceanic and Atmospheric Administration.

(b) "Assistant Administrator" means the Assistant Administrator for Coastal Zone Management, National Oceanic and Atmospheric Administration.

(c) "Bulk discharge" means a discharge of drill fluids and cuttings other than that of materials separated out by properly operating shale shaker, desander and desilter units; i.e. drill fluids and cuttings contained on the drill facility at the termination of drilling each well hole and drill fluids and cuttings evacuated from the drill fluid system during the course of drilling, for the purpose of reconstituting the operational drill fluid.

(d) "Person" means any private individual, partnership, corporation, or other entity; or any officer, employee, agent, department, agency or instrumentality of the Federal government, or any state or local unit of government.

934.5. Allowed Activities:

All activities except those specifically prohibited by section 934.6 may be carried on in the Sanctuary subject to any prohibit-

ions, restrictions or conditions imposed by any applicable regulations, permit, license, or other authorization.

934.6. Prohibited Activities.

(a) Except as may be immediately and urgently necessary for the protection of life or the environment, or as may be permitted by the Assistant Administrator in accordance with sections 934.9 or 934.10, or as limited by subsection (b), the following activities are prohibited within the Sanctuary:

(1) Removing or damaging distinctive natural features - generally.

(A) No person shall break, cut or similarly damage or destroy any coral or bottom formation, any marine invertebrate or any marine plant. Divers are prohibited from handling coral or standing on coral formations.

(B) No person shall collect or remove any coral or bottom formation, or marine plant. No person shall take, except incidentally to other fishing operations, any marine invertebrate (except for dead shells) nor any tropical fish which is a fish of minimal sport and food value, usually brightly colored, often used for aquaria purposes and which lives in a direct interrelationship with the corals. There shall be a rebuttable presumption that any items listed in this paragraph found in the possession of a person within the Sanctuary have been collected or removed from within the Sanctuary.

(C) No person shall use poisons, electric charges, explosives or similar methods to take any marine animal or plant.

(2) Injurious Vessel Operations.

(A) No vessel except a recreational vessel shall anchor within the area of the Sanctuary defined by the 100m (328 ft.) isobaths.

(B) No person shall place any rope, chain, or anchor in such a way as to injure any coral or other bottom formation anywhere within the Sanctuary. All practicable efforts shall be taken to drop anchors on sand flats off the reefs and place them so as not to drift into the coral formations. When anchoring dive boats, the first diver down shall inspect the anchor to ensure that it is placed off the corals and will not shift in such a way as to damage corals. No further diving is permitted until the anchor is placed in accordance with these requirements.

(C) All vessels from which diving operations are being conducted shall fly in a conspicuous manner the international code flag alpha "A" and no vessel under power shall approach closer than 300 ft. (92 m) to a boat displaying the diving flag except at a maximum speed of 3 knots.

(3) Altering of or construction on the seabed.

No person shall dredge, drill, or otherwise alter the seabed in any way, nor construct any structure except for navigation aids, within the area of the Sanctuary defined by the 100m (328 ft.) isobaths.

(4) Trawling within the 100m isobaths

No person shall trawl or drag bottom gear within the area of the Sanctuary defined by the 100m (328 ft.) isobaths.

(5) Discharging polluting substances.

No person shall deposit or discharge any materials or substances

of any kind except

(A) indigenous fish or parts

(B) effluents from marine sanitation devices

(C) non-polluted cooling waters from ocean vessels

(D) effluents incidental to hydrocarbon exploration and exploitation activities as allowed by section 934.7.

(b) The prohibitions in this section are not based on any claim of territoriality and will be applied to foreign persons and vessels only in accordance with recognized principles of international law, including treaties, conventions and other international agreements to which the United States is signatory.

934.7. Hydrocarbon Operations

(a) Within the 85 m isobaths, as defined by the quarter-quarter-quarter system in Appendix A, or within the 100 m (328 ft.) isobaths where such area extends further from the midpoint of either bank (27°55'07.44"N; 93°36'08.49"W for the East Bank and 27°52'14.21"N; 93°48'54.79"W for the West Bank) exploration for or exploitation of hydrocarbons is prohibited.

(b) Outside the area defined by paragraph (a), hydrocarbon exploration and exploitation pursuant to any lease executed prior to the effective date of these regulations is allowed subject to all prohibitions, restrictions and conditions imposed by applicable regulations, permits, licenses or other authorizations including those issued by the Department of the Interior, the Coast Guard, the Corps of Engineers and the Environmental Protection Agency, and subject further to the following:

(i) Cuttings and adherent drilling muds must be shunted to within 6 m of the bottom.

(ii) Bulk discharges of drilling muds are prohibited.

(iii) The simultaneous discharge of the effluents from more than one well from a single rig or platform is prohibited.

(iv) The effects of drill cuttings and effluents upon Sanctuary resources shall be monitored at least once before drilling, frequently during drilling, and at least once after drilling in accordance with the specific requirements set forth in the permits issued by the Environmental Protection Agency pursuant to Section 402 of the Federal Water Pollution Control Act, 33 U.S.C. 1431 in agreement with NOAA.

(c) Hydrocarbon exploration and exploitation activities pursuant to leases executed on or after the effective date of these regulations are prohibited anywhere in the Sanctuary for a period of five years from such effective date.

934.8. Penalties for Commission of Prohibited Acts.

a. Section 303 of the Act authorizes the assessment of a civil penalty of not more than $50,000 against any person subject to the jurisdiction of the United States for each violation of any regulation issued pursuant to the Act, and further authorizes a proceeding in rem against any vessel used in violation of any such regulation. Procedures are set out in Subpart D of Part 922 (15 CFR Part 922) of this chapter. Subpart (D) is applicable to any instance of a violation of these regulations.

934.9. Permit Procedures and Criteria.

a. Any person in possession of a valid permit issued by the Assistant Administrator in accordance with this section may conduct any activity in the Sanctuary including any activity specifically prohibited under section 934.6 if such activity is either (1) research related to the resources of the Sanctuary or (2) to further the educational value of the Sanctuary, or (3) for salvage or recovery operations.

b. Permit applications shall be addressed to the Assistant Administrator for Coastal Zone Management, Attn: Office of Sanctuary Programs, Division of Operations and Enforcement, National Oceanic and Atmospheric Administration 3300 Whitehaven Street, N.W., Washington, D.C. 20235. An application shall provide sufficient information to enable the Assistant Administrator to make the determination called for in paragraph (c) below and shall include a description of all activities proposed, the equipment, methods, and personnel (particularly describing relevant experience) involved, and a timetable for completion of the proposed activity. Copies of all other required licenses or permits shall be attached.

c. In considering whether to grant a permit the Assistant Administrator shall evaluate such matters as (1) the general professional and financial responsibility of the applicant; (2) the appropriateness of the methods envisioned to the purpose(s) of the activity; (3) the extent to which the conduct of any permitted activity may diminish or enhance the value of the Sanctuary as a source of recreation, educational or scientific information; (4) the end value of the activity and (5) such other matters as deemed appropriate.

d. In considering any application submitted pursuant to this Section, the Assistant Administrator may seek and consider the views of any person or entity, within or outside of the Federal Government, and may hold a public hearing, as deemed appropriate.

e. The Assistant Administrator may, in his or her discretion, grant a permit which has been applied for pursuant to this Section, in whole or in part, and subject to such condition(s) as deemed appropriate.

The Assistant Administrator or a designated representative may observe any permitted activity and/or require the submission of one or more reports of the status or progress of such activity any information obtained shall be made available to the public.

f. The permit granted under paragraph (e) may not be transferred.

g. The Assistant Administrator may amend, suspend or revoke a permit granted pursuant to this Section, in whole or in part, temporarily or indefinitely, if the permit holder (the Holder) has acted in violation of the terms of the permit or of the applicable regulations. Any such action shall be in writing to the Holder, and shall set forth the reason(s) for the action taken. The Holder may appeal the action as provided for in 934.11.

934.10. Certification of Other Permits

All permits, licenses and other authorizations issued pursuant to any other authority are hereby certified and shall remain valid if they do not authorize any activity prohibited by section 934.6. Any interested

person may request that the Assistant Administrator offer an opinion on whether an activity is prohibited by these regulations.

934.11. Appeals of Administrative Action authorized by an agency.

Any interested person (the Appellant) may appeal the granting, denial or conditioning of any permit under section 934.9 to the Administrator of NOAA. In order to be considered by the Administrator, such appeal shall be in writing, shall state the action(s) appealed and the reason(s) therefore, and shall be submitted within 30 days of the action(s) by the Assistant Administrator. The Appellant may request an informal hearing on the appeal.

b. Upon receipt of an appeal authorized by this Section, the Administrator shall notify the permit applicant, if other than the Appellant and may request such additional information and in such form as will allow action upon the appeal. Upon receipt of sufficient information, the Administrator shall decide the appeal in accordance with the criteria set out in 934.9(c) as appropriate, based upon information relative to the application on file at OCZM and any additional information, the summary record kept of any hearing and the Hearing Officer's recommended decision, if any, as provided in paragraph (c) and such other considerations as deemed appropriate. The Administrator shall notify all interested persons of the decision, and the reason(s) therefore, in writing normally within 30 days of the receipt of sufficient information, unless additional time is needed for a hearing.

c. If a hearing is requested or if the Administrator determines one is appropriate, the Administrator may grant an informal hearing before a Hearing Officer designated for that purpose after first giving notice of the time, place, and subject matter of the hearing in the Federal Register. Such hearing shall normally be held no later than 30 days following publication of the notice in the Federal Register unless the Hearing Officer extends the time for reasons deemed equitable. The Appellant and the Applicant, if different and, at the discretion of the Hearing Officer, other interested persons, may appear personally or by counsel at the hearing and submit such material and present such arguments as determined appropriate by the Hearing Officer. Within 30 days of the last day of the hearing, the Hearing Officer shall recommend in writing a decision to the Administrator.

e. The Administrator may adopt the Hearing Officer's recommended decision, in whole or in part, or may reject or modify it. In any event, the Administrator shall notify interested persons of the decision, and the reason(s) therefor in writing within 30 days of receipt of the recommended decision of the Hearing Officer. The Administrator's action shall constitute final action for the Agency for the purposes of the Administrative Procedure Act.

f. Any time limit prescribed in this Section may be extended for a period not to exceed 30 days by the Administrator for good cause, either upon his or her own motion or upon written request the Appellant or Applicant stating the reason(s) therefor.

Appendix A: Definition of the 85 M Isobaths at East and West Flower Garden Banks From the Bureau of Land Management Lease Stipulations

East Flower Garden Bank:

High Island Area, East Addition, South Extension, Block A-366: S½SE¼

High Island Area, East Addition, South Extension, Block A-374: SW¼NW¼NW¼; NW¼SW¼NW¼; S½SW¼NW¼; SW¼NE¼SW¼; W½SW¼; W½SE¼SW¼; SE¼SE¼SW¼

High Island Area, East Addition, South Extension, Block A-375: E½; SE¼NE¼NW¼; N½SE¼NW¼; SE¼SE¼NW¼; E½SW¼

High Island Area, East Addition, South Extension, Block A-388: NE¼; NE¼NW¼; N½SE¼NW¼; SE¼SE¼NW¼; N½N½SE¼; S½NW¼SE¼; SW¼NE¼SE¼

High Island Area, East Addition, South Extension, Block A-389: N½NW¼; SW¼NW¼; N½SE¼NW¼; SW¼SE¼NW¼; N½NW¼SW¼

West Flower Garden Bank:

High Island Area, East Addition, South Extension, Block A-383: NE¼SE¼SE¼; S½SE¼SE¼

High Island Area, East Addition, South Extension, Block A-384: NW¼SW¼NE¼; S½S½NE¼; SE¼NW¼; N½NE¼SW¼; NE¼NW¼SW¼; S½N½SW¼; S½SW¼; SE¼

High Island Area, East Addition, South Extension, Block A-397: W½W½NW¼; W½NW½SW¼; NW¼SW¼SW¼

High Island Area, East Addition, South Extension, Block A-398: All

High Island Area, East Addition, South Extension, Block A-399: E½; SE¼NE¼NW¼; E½SE¼NW¼; E½NE¼SW¼; NE¼SE¼SW¼

High Island Area, East Addition, South Extension, Block A-401:

N½N½NE¼; S½NE¼NE¼; NE¼SE¼NE¼

Garden Banks Area, Block 134:

That portion of the block to the north of the line connecting Points 17 and 18, defined as follows:

Point 17: X=1,378,080.00'; Y=10,096,183.04';

Point 18: X=1,367,079.41'; Y=10,096,183.04';

Universal Transverse Mercator Grid System

Garden Banks Area, Block 135:

That portion of the block to the northwest of the line connecting Points 16 and 17, defined as follows:

Point 16: X=1,383,293.84'; Y=10,103,281.93';

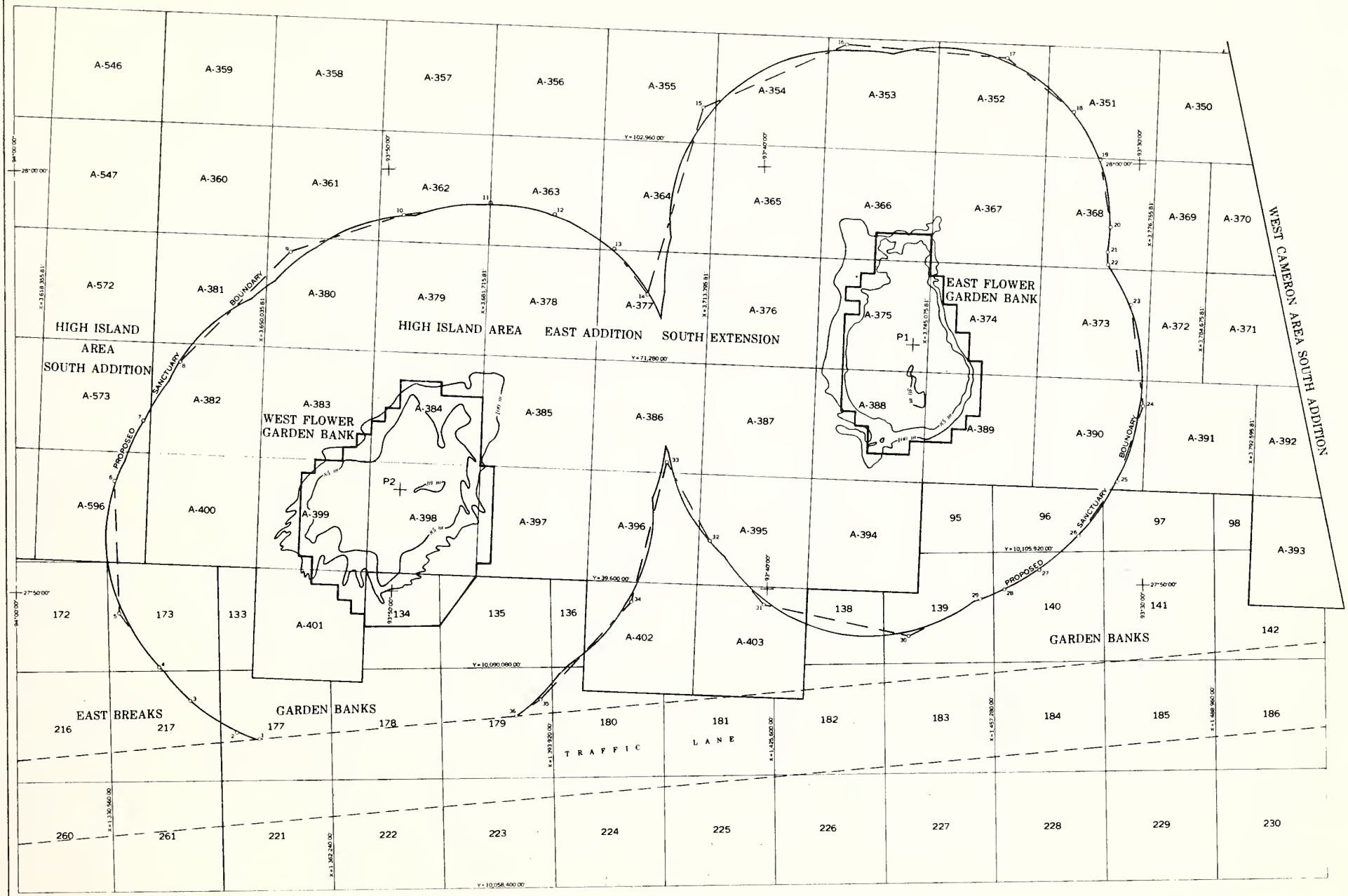
Point 17: X-1,378,080.00'; Y=10,096,183.04';

Universal Transverse Mercator Grid System.

Appendix B: Boundary of the Flower Garden Banks Marine Sanctuary

The Boundary of the Flower Garden Banks Marine Sanctuary is 4 nautical miles from the 100 meter isobath around each Bank. The boundary can be approximated by lines connecting the following points. (See attached map for location of points.)

	Latitude	Longitude
1.	27°46'30.5"N	93°53'31.7"W
2.	27°46'39.6"	93°54'07.9"
3.	27°47'25.1"	93°55'22.0"
4.	27°48'13.2"	93°56'11.6"
5.	27°49'30.3"	93°57'15.5"
6.	27°52'38.7"	93°57'21.9"
7.	27°54'04.1"	93°56'35.2"
8.	27°55'27.4"	93°55'35.6"
9.	27°58'03.0"	93°52'37.9"
10.	27°58'54.6"	93°49'36.7"
11.	27°59'11.1"	93°47'17.3"
12.	27°58'54.4"	93°45'35.3"
13.	27°58'04.8"	93°44'00.6"
14.	27°56'59.6"	93°43'08.0"
15.	28°01'24.8"	93°41'36.4"
16.	28°02'53.1"	93°37'46.3"
17.	28°02'31.6"	93°33'29.8"
18.	28°01'14.2"	93°31'44.2"
19.	28°00'06.4"	93°31'02.6"
20.	27°58'30.0"	93°30'47.1"
21.	27°57'54.6"	93°30'52.2"
22.	27°57'36.6"	93°30'51.4"
23.	27°56'39.7"	93°30'15.4"
24.	27°54'15.3"	93°29'57.2"
25.	27°52'27.8"	93°30'39.2"
26.	27°51'11.2"	93°31'42.0"
27.	27°50'23.5"	93°32'45.2"
28.	27°49'56.1"	93°33'41.1"
29.	27°49'42.3"	93°34'19.5"
30.	27°48'51.1"	93°36'14.5'
31.	27°49'37.2"	93°40'05.6"
32.	27°51'08.7"	93°41'31.1"
33.	27°53'01.1"	93°42'39.0"
34.	27°49'43.0"	93°43'36.8"
35.	27°47'24.4"	93°46'02.5"
36.	27°47'01.3"	93°46'41.4"



Proposed boundary of the Flower Garden Banks Marine Sanctuary showing the locations of points for approximating the boundary.

EAST AND WEST FLOWER GARDEN BANK AREAS

PROTECTIVE RESTRICTIONS BOUNDARIES

SCALE 1" = 1000'

Appendix C: NOAA/EPA PRINCIPLES OF AGREEMENT

Coordination of Regulations and Permits

for Flower Garden Banks

The following represents a joint statement of policy by the NOAA/EPA Interagency Committee for Program Coordination:

(1) In carrying out their respective responsibilities under Section 402 of the Clean Water Act (CWA) and under Section 302 of the Marine Protection, Research, and Sanctuaries Act (MPRSA), EPA and NOAA agree that, to the maximum extent practicable, they will establish consistent conditions governing oil and gas activities in the proposed Flower Garden Banks Marine Sanctuary (Sanctuary). The conditions agreed upon are attached.

(2) EPA shall issue guidance to the Regional Administrator of Region VI for the development of permit conditions under Section 402 of the CWA for discharges from oil and gas activities within the waters proposed as the Sanctuary, which guidance shall be consisent with the attached conditions to the maximum extent practicable.

(3) NOAA's proposed regulations under Section 302 of the MPRSA relating to discharges from oil and gas activities in the Sanctuary, shall be consistent with the conditions agreed upon with EPA.

James P. Walsh
Deputy Administrator
National Oceanic and
Atmospheric Administration

3/14/79
Date

Thomas C. Jorling
Assistant Administrator for
Water and Waste Management
Environmental Protection Agency

2/13/79
Date

Flower Garden Marine Sanctuary Regulations
and Permit Conditions

A. Sanctuary Boundary: 4 nautical miles from the 100 meter isobaths.

B. No Activity Zone: either: within 85-meter isobaths as defined by quarter-quarter system; or, 100-meter isobaths, whichever is farther from the Banks' midpoints.

C. Conditions for Allowing Operations: No oil or gas operations will be allowed in the sanctuary until a National Pollutant Discharge Elimination System (NPDES) permit has been issued.

1. Shunting of cuttings and adhering drilling muds: to within 6 meters of the seabed within sanctuary defined above.

2. Monitoring: all leases within the sanctuary defined above.

3. Monitoring Requirements: once before, frequently during and once after drilling, with parameters, timing, and other requirements as specified in NPDES permit. Such specifications shall in general be agreed upon by NOAA and EPA.

4. Bulk Discharge of Muds: prohibited within sanctuary defined above.

5. Contingency Plans (for spills of oil and hazardous materials, and for procedures to be followed if Regional Administrator imposes a "no-discharge" permit condition.): required as specified in NPDES permit and sanctuary regulations and agreed upon by NOAA and EPA.

6. Other Discharges - Produced water, Deck drainage, Cooling waters, and Sanitary wastes: in compliance with NPDES permit conditions.

7. Non-Simultaneous Drilling and Discharge (sequential drilling of and discharge from one well at a time from a single platform): required in sanctuary with provision for reconsideration via the conditions of an NPDES permit.

D. Five-Year Moratorium: Five-year moratorium on operations on unsold leases and future leasing within 4 nautical miles of the 100 meter isobaths.

D. PURPOSE AND NEED FOR ACTION

The Flower Garden Banks represent a unique natural blend of biological assemblages. Highlighted by two coral reef caps, the northernmost living coral reefs on the U.S. continental shelf, the Banks offer a combination of aesthetic appeal and recreational and research opportunity matched by few other ocean areas. Not unexpectedly, an area with these characteristics is also one in a delicate ecological balance. Because of the fragile nature of coral and the fact that the Banks lie on the extreme northern edge of the zone in which extensive reef development can occur, the Flower Gardens are particularly susceptible to man-induced impacts. Pressures which in another setting could be readily and, perhaps, harmlessly accommodated pose real threats to the Banks sensitive coral reef community.

While the Banks up to this time, have withstood those pressures put upon them, such success cannot realistically be expected in the future without deliberate protection. Numerous uses of the marine environment around the Flower Gardens are already taking place, and the level of activity is increasing. Development of continental shelf oil and gas resources has begun within a few miles of the Flower Gardens' live coral banks, and a significant increase in the exploration and exploitation of these oil and gas resources will occur soon. Recreationists frequently visit Flower Gardens to dive, fish, and enjoy the reef's natural amenities. Shipping fairways surround the Banks and are used by commercial vessels

carrying a variety of substances, most notably oil. Research activities and some commercial fishing also take place at and near the Flower Garden Banks on a regular basis.

In light of the increasing pressures being placed upon the valuable but fragile Flower Garden Banks ecosystem, they were considered for marine sanctuary designation in the early 1970's. NOAA and the Department of the Interior in conjunction with the State of Texas had reviewed and analyzed the proposed sanctuary. The appropriate agreements never were reached, however, and the sanctuary designation was not made at that time. Renewed interest in the designation was kindled in 1977 after the President's Environmental Message, and Texas State Senator A.R. Schwartz in conjunction with the Texas Coastal and Marine Council submitted a nomination for the designation of the Banks as a marine sanctuary.

Increasing pressures such as OCS oil and gas development, biological research, recreation, fishing, and the lack of a well coordinated and administered protective regime demonstrate the need for the marine sanctuary designation. Well-defined regulations would assure the protection and preservation of the recreational, ecological, and aesthetic values that make the Flower Garden Banks so unique.

There are deficiencies in the existing regulations. No authority protects the ecosystem i.e., the community of living organisms that interact in a complex and little understood manner. For instance,

the Bureau of Land Management offers some protection to the corals themselves, but BLM authority has not dealt with the problem of anchor damage. Prohibitions on oily and other potentially harmful discharges are insufficient for an ecosystem of such vulnerability. There presently is no program for long-term assessment at the Banks. The proposed marine sanctuary regulations are necessary and justified by such deficiencies in existing regulations as are illustrated above and are relatively low cost, enforceable and realistic measures that will provide a sufficient level of environmental protection at minimum expense to the public and private sectors. The proposed marine sanctuary regulations build upon existing regulations and provide the additional resource protection where needed.

The management program for the sanctuary will assure protection, utilization, study, and care of the Flower Garden Banks. The management program will accomplish these goals by: 1) prohibiting those activities (such as anchoring on the live reefs) that have been proven to be damaging to the resources, 2) controlling through a permit system established under the sanctuary regulations certain activities that have potential for causing damage to the resources, 3) contracting for onsite management and review of permit applications, 4) providing for surveillance and enforcement to ensure that the regulations are being followed, and 5) establishing an assessment program to study the existing and potential environmental impacts and to provide information for management decisions. At the present time, the resources of the Flower Garden Banks are threatened, and no comprehensive management program of the kind presented above exists.

E. DESCRIPTION OF THE AFFECTED ENVIRONMENT

1. General

Section E of this DEIS describes the environment of the Flower Garden Banks. A brief description is given of the location and geological, physical, chemical, and biological features of the Flower Garden Banks. This description stresses the area's conservation, recreational, ecological, and aesthetic qualities that compose values worthy of protection. All human activities taking place over, on, or near the Banks which presently or potentially affect one or more of the valuable resources of the Flower Garden Banks are discussed (see Sections 2 through 7). Those activities which pose the greatest threats to the Flower Gardens ecosystem are discussed in more detail than those of minor concern; all activities that have a reasonable possibility of affecting the Banks environment are mentioned.

a. Location

The proposed marine sanctuary at Flower Garden Banks is located at the outer edge of the continental shelf (see Figure E-1). Each Bank is defined by a base reference point: West Flower Garden by point P1 at 27° 52'14.21"N and 93° 48'54.79"W and East Flower Garden Bank by point P2 at 27° 55'07.44"N and 93° 36'08.49"W. Points P1 and P2 are also used by the Bureau of Land Management (BLM), U.S. Department of the Interior, for offshore leasing purposes. These points are described by BLM using the Texas Lambert System, with P1 at x = 3,670,300; y = 51,500, and P2 at x = 3,792,910; y = 71,500. As noted on Figure E-1, the Banks

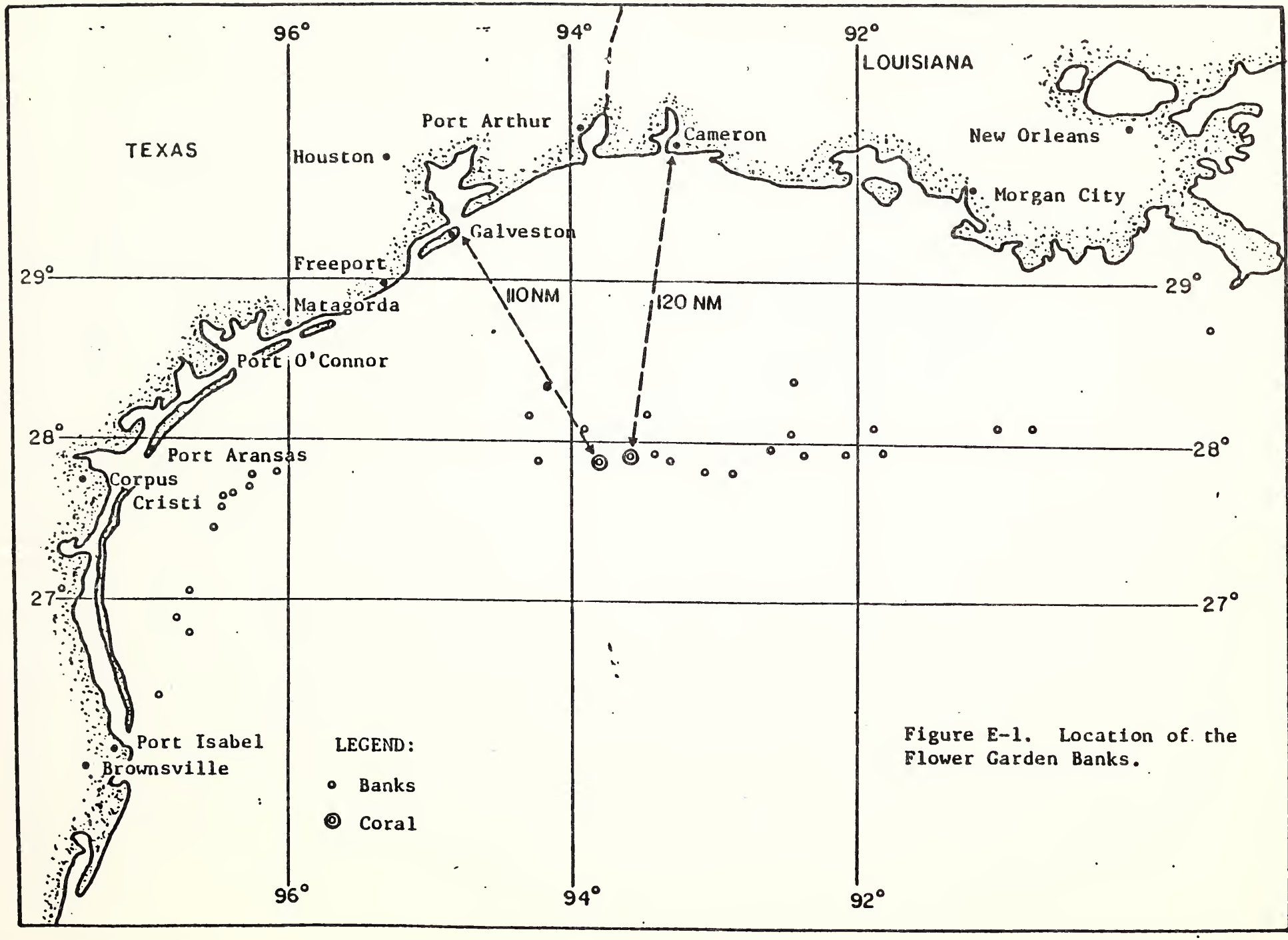


Figure E-1. Location of the Flower Garden Banks.

are located due south of the Texas and Louisiana border. The East Flower Garden is approximately 222 km (120nm) south southwest of Cameron, Louisiana; the West Bank is situated 203km (110nm) southeast of Galveston, Texas. The distance between the Banks is about 25 km (13.5nm).

b. Geological

The Flower Garden Banks are located on the Texas-Louisiana Shelf near the transition zone to the continental slope. The Banks are part of a much larger geologic feature covering Tertiary bedrock with sediments of Quaternary origins in the pleistocene epoch. The salt dome structure (see discussion below) of the Banks punctuates the surrounding peorian geomorphic type (Bureau of Land Management, 1978a). Sediments on the shelf and slope areas near the Banks range from clays in the southwest to gravel-sand-shell fragments to the east. Within 50 km (27nm) of either Bank reference point, the sediments are predominantly sand-silt-clay and silty clay (Bureau of Land Management, 1978a) (see Figure E-2). Deposits of sand and gravelly sand occur northeast and east of the East Bank. Generally, sediments north (shoreward) are sand and silty and finer silty clay deposits occur south (shelfward).

East and West Flower Gardens are characterized by a salt dome infrastructure, as are most of the other Gulf of Mexico banks above 27^{o} 46'N latitude (Bright and Rezak, 1978). Salt domes, also referred to as salt plugs, are stalklike projections of rock salt that penetrate

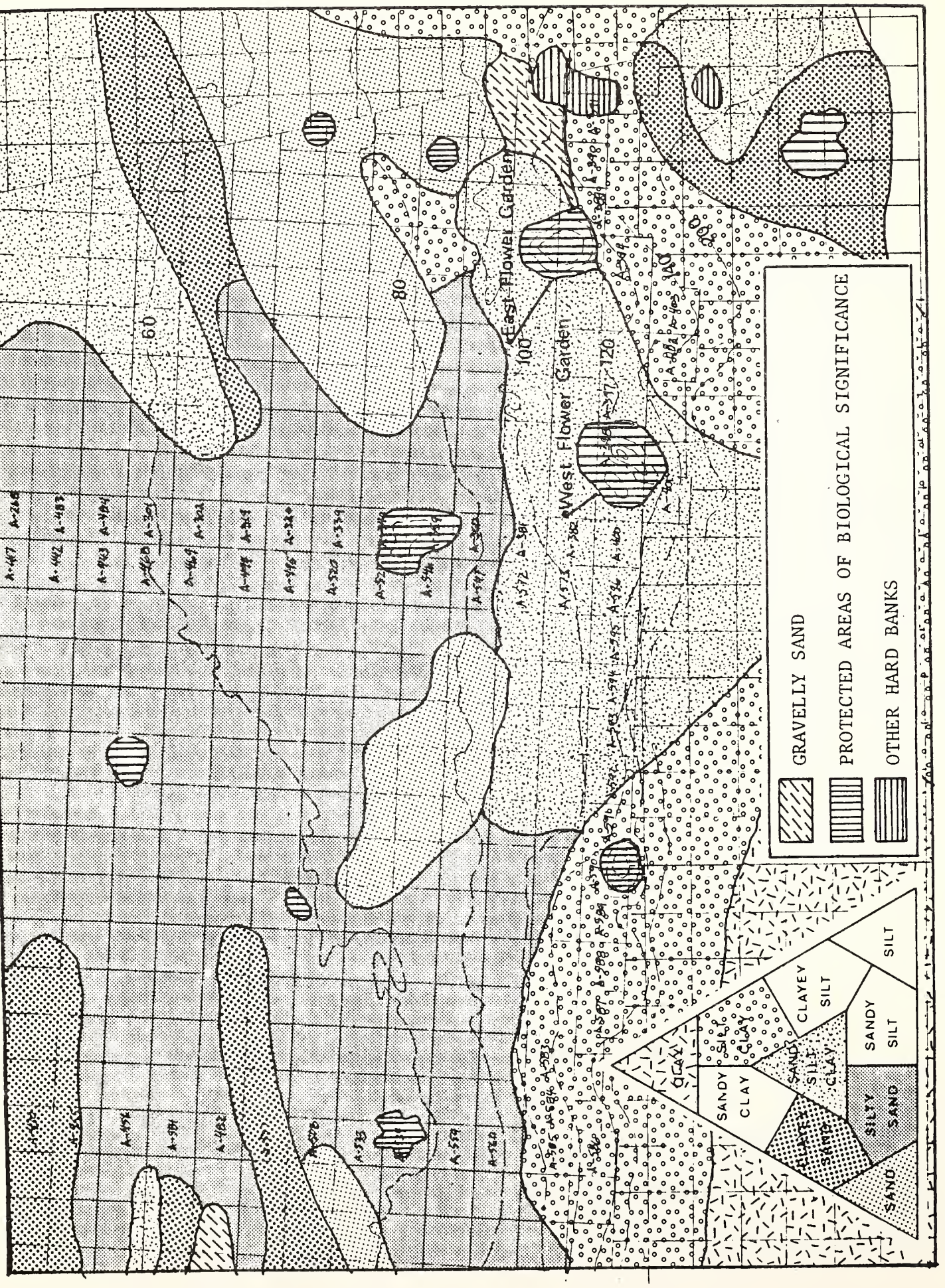


Figure E-2. Bottom sediments at the Flower Garden Banks

hundreds or thousands of meters of strata. The upward forces during these formations causes numerous fractures to occur along existing rock layers. Gaps caused by the faults and fractures create traps for oil and gas collection. Salt domes such as Flower Garden Banks often extend as much as 12 km (7.5 mi) into the crust and rise through the sediments of the seafloor.

East Flower Garden Bank is a tear-shaped dome approximately 9.5 km by 6.7 km, with the long axis directed north-south. As described by Bright and Rezak (1978), the Bank has relatively steep east and southeast marginal slopes between about 50 m (160 ft) to 110 or 120 m (360 or 390 ft); the west and northern flanks are more gradual. The cap is characterized by a terrace at 40 to 50 m, (130 to 160 ft) from which two pinnacles rise--the northern peak to 24 m (80 ft), the southern peak to 16 m (52 ft) of the sea surface.

West Flower Garden Bank rises from a maximum depth of 136 m (450 ft) on the south to a height of 20 m (66 ft) below the sea surface (Rezak, 1977). The living reef cap, to a depth of 45 m (150 ft), has steeply sloped sides of 45^{o} to vertical. Scattered on these sides are steep-walled canyons that serve as channels of sediment transport to the surrounding apron of the reef. Several drowned dead reefs and isolated patch reefs of living coral occur on the sediment apron that extends to the shelf.

Several issues of relevance to the geology of Flower Garden Bank are discussed in the following sections. Activities associated with oil and gas development are addressed in Sections E.2.a-d and the potential effects of vessel anchoring and groundings are discussed in Sections E.4.c and E.4.d.

c. Physical

The physical environment in which the Flower Garden Banks occur is typical of the continental shelf areas of the northwestern Gulf of Mexico. Generalized current patterns, tidal regimes, temperature/salinity profiles, and peculiarities of each are presented below.

The Flower Garden Banks are located on a portion of the Texas-Louisiana Shelf characterized by a westward sweep of surface currents (Nowlin, 1971). Vast differences in current velocity (about 0.2 to 1.0 kts) and direction occur over monthly and annual periods. The U.S. Bureau of Land Management (1978a) reported resultant surface current directions of 305.3^{o} and 301.3^{o} for sites southeast and southwest of the Banks on the shelf-slope interface. The mean current speeds for those sites in the resultant directions are 0.2 and 0.3 kts; current speeds in all directions averaged 0.5 to 0.8 kts. Bottom current directions correspond to surface currents during early fall and mid-winter but are otherwise quite different (National Oceanic and Atmospheric Administration, 1976). Tides in the area are mixed and have little influence on the Banks (U.S. Bureau of Land Management, 1978a).

Bottom currents in the vicinity of the Flower Garden Banks are typified by a nepheloid layer--bottom waters which are cloudy from suspended detrital sediment (McGrail, 1978, personal communication). The nepheloid layer is, in turn, an integral component of the bottom boundary layer. Formed by water flowing along the sediments, the nepheloid layer accumulates bottom materials at rates dependent upon local sediment type, the intensity of turbulence present, and the degree of stratification in the water column. Vertical displacements of the layer above the bottom is initiated by eddying currents caused by slight deformations of the sediment surface. These eddies are also responsible for homogenizing water masses of differing temperatures and salinities. The interface of these mixed bottom waters with waters nearer the surface represents a boundary to materials passing in either direction (McGrail, 1978, personal communication). Materials originating below the nepheloid layer would be unlikely to rise through the boundary. Similarly, surface materials could be transported long distances before sinking to the bottom. The nepheloid layer is well below the coral reefs (50 to 60 m) at all times (Bright, 1977). It ranges in thickness from 1 meter to 20 meters in the vicinity of the Flower Gardens (EPA, 1978) and materials deposited near the bottom may not necessarily be deposited in the nephloid layer because it rises and falls and does not always hug the seabed. (McGrail, 1978, personal communication.)

Water temperatures near Flower Gardens exhibit an annual range typical of the Gulf region. In the summer months, sea surface

temperatures average about 29°C; winter isotherms of 18° to 24° occur on a north to south gradient in the Gulf with the average near the Flower Gardens of 20°C (Berryhill, 1977). Temperatures at the reef depths have not been recorded.

Several of these physical characteristics, especially the nepheloid layer, are discussed below concerning specific issues at the Flower Gardens. In Section E.2.b. the discharge of drill cuttings and muds is analyzed relative to water stratification and the nepheloid layer. The impacts of fishing and research operations upon the physical formations of the reefs are discussed in Sections E.5.b. and E.6., respectively.

d. Chemical

The chemical environment of the Banks region is fairly constant. Surface salinities average about 35 to 36 parts per thousand (ppt) depending upon the season, precipitation, the freshwater; seawater ratio, circulation patterns, and mixing (Nowlin, 1972). Seasonality may strongly affect nearshore-offshore gradients that could extend to the Flower Gardens.

e. Biological

The dominant biological feature of each Bank is the zonation of communities along the depth gradient. Research by submersibles and divers has established clear perspectives of the flora and fauna found on each reef. Depth, and therefore light penetration intensity, turbidity, water temperature, and other factors, seems to be the key determinant of zonation patterns.

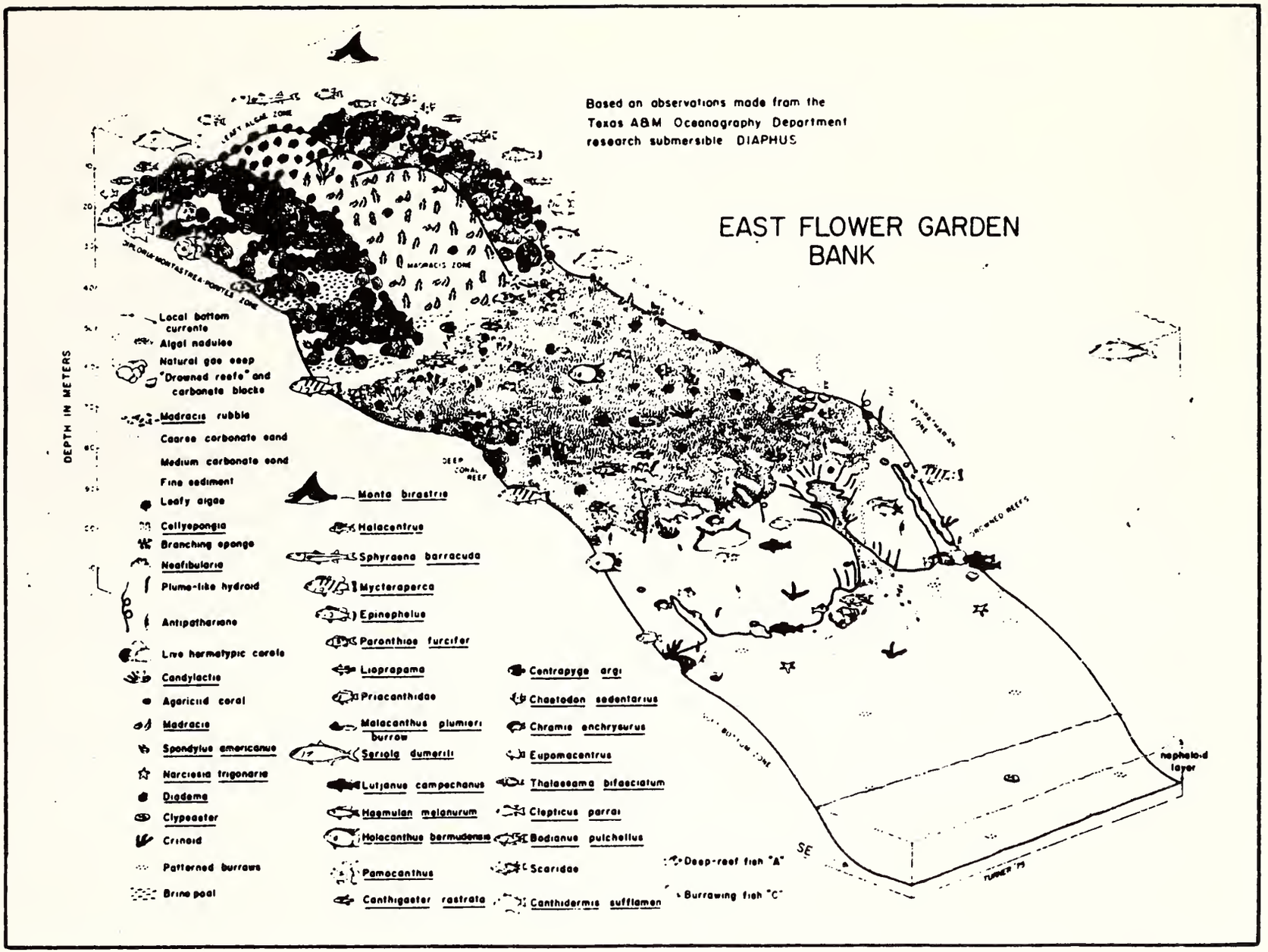


Figure E-3. Biotic zonation of East Flower Garden Bank

The East Flower Garden Bank (Figure E-3) is characterized by eight distinct zones from the cap at about 20 m (66 ft) to the base of the soft bottom at 110 to 120 m (360 to 390 ft). These are:

- The leafy algae zone
- The Madracis Coral zone
- The Diploria - Montastrea - Porites Coral zone
- The algae-sponge zone
- The deep coral reef zone
- The antipatharian zone
- The transition crinoid zone
- The soft bottom zone (Bright, 1977).

Generally, all but the last zone occur on the hard bank and 1 to 3 within the "live coral reef" area.

On the East Flower Garden Bank, Bright and Rezak (1976) observed approximately 65 species of fish, 19 species of stony corals, 11 species of leafy algae, 8 species of sponges, and about another 25 species of benthic invertebrates (crabs, starfish, sea urchins, worms, shrimp, octopi, squid, snails, and others). Based on the number of observations by Bright and Rezak (1976), groupers, yellowtail, and great barracuda appear to be the most common finfish and Diploria and Montastrea are the most abundant anthozoan stony corals. Diversity was very high and abundance generally low in each taxonomic heading. Tabular summaries of all species observed, frequency of siting, and depth of observation are presented in Bright and Rezak (1976).

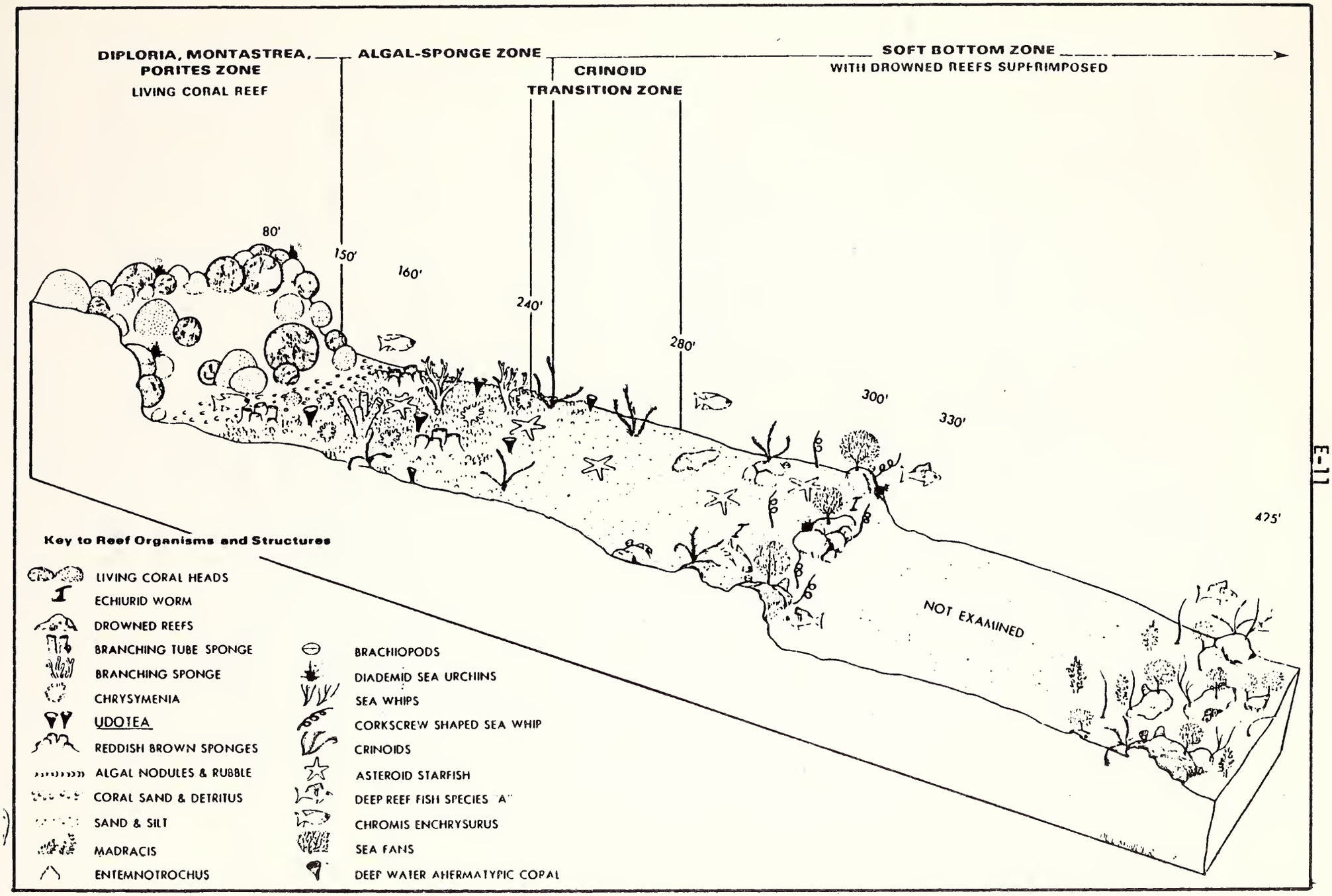


Figure E-4. Biotic zonation of West Flower Garden Bank

West Flower Garden Bank exhibits zonation communities different from those observed at the East Bank (Figure E-4). From its shallowest peaks at about 20 to 25 m (66 to 82 ft) to the base at 136 m (450 ft), the West Bank is categorized into five zones:

- The Diploria - Montastrea - Porites coral zone
- The algae - sponge zone
- The deep coral reef zone
- The transition crinoid zone
- The soft bottom zone (Bright, 1974).

In contrast to the East Bank this Bank lacks the upper reef leafy algae and Madracis coral zones. Antipatharian corals have been observed amidst the soft bottom zone. At the West Flower Garden Bank zones 1 to 4 correspond to the hard bank.

A book edited by Bright and Pequegnat (1974) on the Biota of the West Flower Garden Bank includes detailed synopses of all species observed on the Bank. Based on that data, 101 species of finfish, 18 species of scleractinian corals, 65 species of mollusks, 63 species of crustaceans, 17 hydroids, 8 species of polychaetous annelids, and 11 species of echinoderms are classified, described, and discussed. Data on all observations are tabulated to present general impressions of abundance and distributions with depth.

The 50 m (164 ft) isobath corresponds to the approximate lower limit of the live coral zones (see Figures E-3 and E-4). This coral cap represents many of the unique biotic zones. The 122 m (400 ft) isobath signifies the approximate base of the hard bank. At approximately the 100 m isobath below the coral cap lie the crinoid zones that are equally important to the health of the reefal ecosystem.

The human activities occurring near the Flower Garden Banks are also elements of the environment affected by the marine sanctuary proposal. The following discusses activities that occur in the vicinity of the Banks, which may be affecting the reefal community and which might be affected by a sanctuary designation and regulation. The activities discussed include:

- OCS oil and gas development
- Recreation
- Commercial shipping
- Fishing
- Research

2. OCS Oil and Gas Development

a. General

Exploratory drilling and production of oil and gas has been and is occurring near or adjacent to several banks in the Gulf of Mexico including the Flower Garden Banks. However, the East and West Flower Garden Banks are the only two that support coral reef communities. The high potential for economically recoverable quantities of oil and gas is confirmed in the vicinity of the Flower Garden Banks by current oil

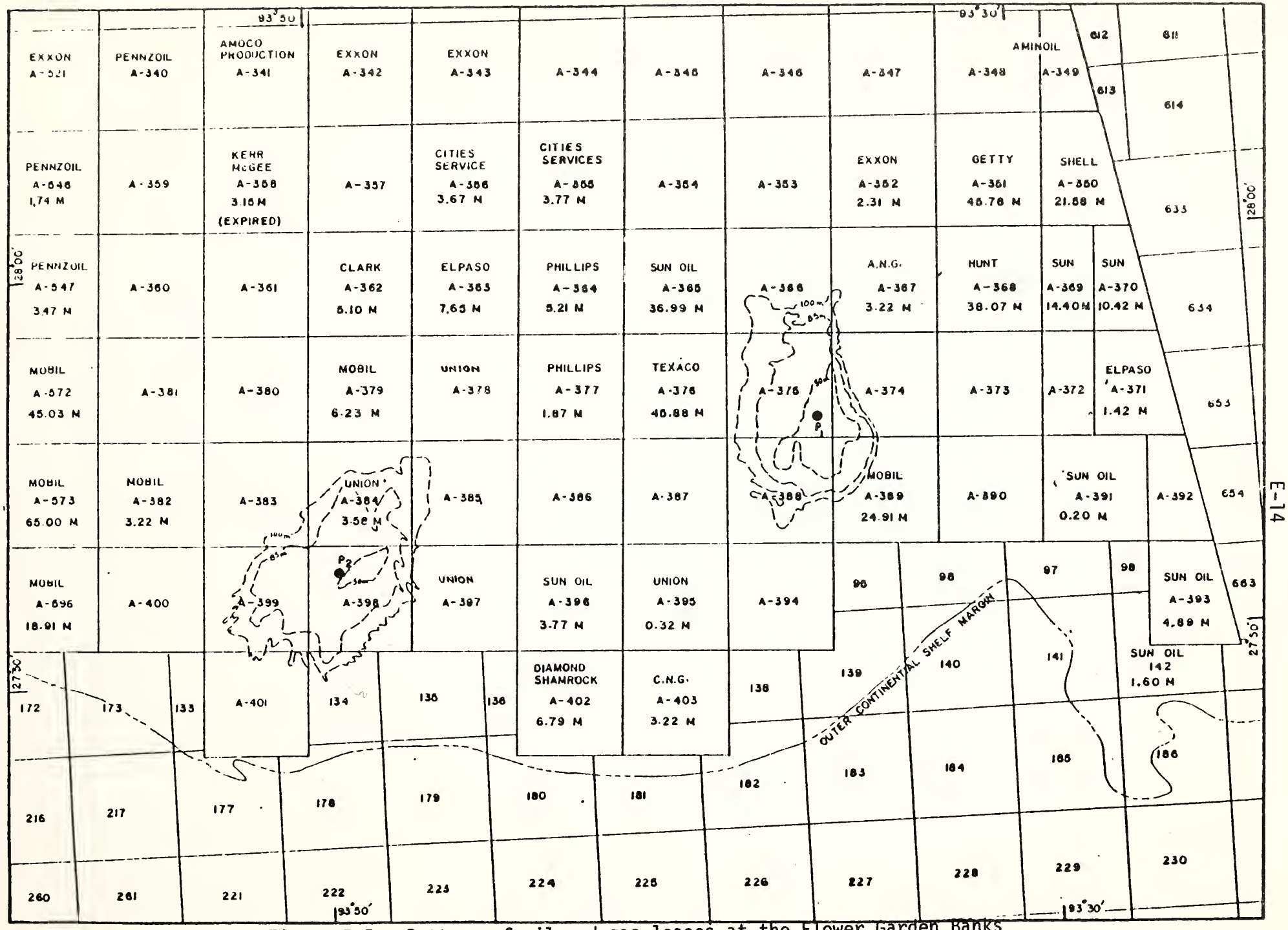


Figure E-5. Pattern of oil and gas leases at the Flower Garden Banks

company activity involving the leasing of tracts, exploratory drilling and production (see Figure E-5). The exploratory drilling closest to a living reef has occurred 1 nm southeast of the East Flower Garden Bank reef on Mobil Oil Corporation's tract A-389. Also, drilling has occurred 2.7 nm north of the West Flower Garden Bank on Union Oil of California's tract A-384. The closest production platforms lie about 9 nm northeast of the East Flower Garden Bank on Sun Oil Company's tract A-370 and 7 nm west of the West Flower Garden Bank reef on Mobil's tract A-573. Mobil has submitted a development and production plan to the U.S. Geological Survey (USGS) for locating of a production platform 1 nm southeast of the East Flower Garden Bank reef on tract A-389. (Recently, in OCS Lease Sale #51 held in December 1978, two tracts near the east flank of the West Flower Garden Bank, A-378 and A-397, were leased to Union Oil Company of California.)

Oil and gas resource development near the Flower Garden Banks requires major investment. Costs to develop OCS lease tracts include the actual price of the lease, the cost of exploration, and the cost of production and transfer of the recovered resource. The costs of the 27 presently leased tracts closest to the Flower Garden Banks range from $203,000 (for block A-391) to $65 million (for block A-573) with an average cost of $16 million per block. The cost of an exploratory well (of which there may be 2 to 4 per leased tract) varies significantly depending on several factors, such as type of rig required, the water

depth, the depth of the hole, and the angle of drilling, but averages about $2 million. Although precise cost estimates for drilling exploratory wells are not available, rental of a drilling rig alone costs tens of thousands of dollars a day. Drilling a well usually takes two or three months (Berri, 1978, personal communication). Mobil Oil Corporation estimates that its average cost of an exploratory well including a monitoring study is $2.5 million at 1978 prices and will be $2.8 million by mid-1979 (C. R. Kruez, 1978, personal communication). A similar estimate found the cost to be close to $2 million per well (Ford Bankstow, 1978, Personal Communication). Appendix 1 presents a review of offshore oil and gas operations.

Mobil Oil Corp., for its planned development on tract A-389, estimates the cost of an 18 well platform in approximately 130 meters (425 feet) of water to be about $17 million (Kreuz, 1978, Personal Communication).

The major environmental concern in the protection of the Banks' natural marine resources is the effect produced by drilling operations near the Banks. Secondary concerns are the impacts from the actual placement of platforms and pipelines. Minor impacts involve discharges of air pollutants, sanitary wastes, cooling water, solid wastes, deck drainages, and formation waters.

Ocean mining initiatives other than oil and gas development are unlikely at the Flower Garden Banks. In light of this situation, OCZM has not considered any regulatory or management options directed at ocean mining in the vicinity of Flower Garden Banks.

b. Discharge of Drilling Effluents (Muds and Cuttings)

During drilling activity an effluent composed of drilling cuttings and adherant muds is discharged into the sea beneath the drilling rig or platform. The drill cuttings are pulverized rock fragments and chips removed from the hole during drilling. Drill muds are chemical mixtures used to cool and lubricate the drill bit, transport drill cuttings to the surface, counterbalance the hydrostatic pressure of reservoir fluids, and minimize corrosion of the drill pipe and casing (Adams, 1978). The American Petroleum Institute's (1978) catalogue of drill mud components lists 54 classes of compounds available for use in mud mixtures, although only about a dozen are used in a typical well. The muds are basically a water-clay suspension with ferrochrome or chrome lignosulfonate added to control viscosity and fluid loss, barium sulfate added to increase density, and sodium hydroxide to maintain a proper pH. In addition bactericides, defoamers, flocculents, detergents, lubricants, emulsifiers, dispersants and other special products may also be added (Adams, 1978) (see also Appendix 2 for a summary of some studies of the chemical and physical effects of drilling effluent discharges.)

Drilling a typical well requires 1 to 3 months. During this period, some 2,000 to 4,000 barrels (bbls) of cuttings and 3,000 to

7,000 bbls of mud may be discharged (Offshore Operators Committee, 1978). However, because drill muds are economically valuable, efforts are made on the drilling platforms to separate them from the drill cuttings pumped up from the hole and to reuse them. Separation is accomplished by passing the cutting-laden mud over "shale shaker" screens and through hydrocyclones. The recovered mud is then returned to a mud tank for recirculation down the hole; but muds that adhere to the surface of discharged cuttings after they pass through the shale shaker represent a continuous loss. Drilling muds may also be disposed as "bulk discharges" from rigs and platforms. Bulk discharges are produced when muds with different physical and chemical properties are needed to replace down-hole muds such as after installation of the surface casing or other casing strings (Sheen Technical Committee, 1976). Bulk discharges may occur once or twice during the drilling of a well. A final bulk discharge may also occur when all drilling from a rig or platform is completed. The volume of bulk discharges usually ranges from 800 barrels (33,600 gal.) (Ottman, 1976; Offshore Operators Committee, 1978) to 1200 barrels (50,400 gal.) (Zingula, 1978).

Drilling operators prefer to discharge excess muds directly from the platform or rig to the surface waters for reasons of convenience and cost. Occasionally, bulk discharges have been prohibited for environmental reasons from platforms. In these cases, the excess muds be transported from

the drilling site to an acceptable ocean or onshore disposal site. There are problems with safety of barges, availability of mud boats, and cost for both barges and mud boats. In biologically sensitive areas BLM traditionally adds a stipulation to the lease which requires that discarded muds and cuttings be shunted to the bottom through a pipe. This procedure is intended to prevent the dispersal of sediment in the water column and to deposit it in the nepheloid layer where it will remain.

In evaluating the environmental effects of drilling discharges, both the toxic effects of the chemical constituents of drill muds and the physical effects of the cuttings need to be considered. These effects are discussed in detail in Appendix 2 and briefly summarized here.

The literature on toxic effects of drilling discharges tends to indicate that while certain toxic effects must be considered potentially significant, most of the chemical constituents of drilling muds are relatively unreactive in a biologic sense and disperse to background concentrations a few thousand feet from the drilling site. A study conducted on a shunted exploratory well near the East Flower Garden Bank (Continental Shelf Associates, 1978) indicates that nearly 50% of the barite discharged in the mud slurry was deposited beyond 1250 meters (0.67 nm) from the bottom of the shunt pipe. Other monitoring programs have shown barium to have

been dispersed beyond a kilometer from the drill site (Continental Shelf Associates, 1976; SUSIO, 1976). Behren, (1977) strongly suggests that sand and clay discharged from an unshunted exploratory drilling rig were dispersed at least 2 km. EPA (1978) and ECOMAR, Inc. (1978) have observed sediment plumes extending 1.5 nm from an unshunted well and beyond 2 nm from a well shunted to mid water (12 meters). Unfortunately, their observations do not represent maximum plume lengths; rather, they represent evidence that visible plumes can travel at least 2 miles. It is not known how far plumes which are not visible to the eye travel.

While the nepheloid layer, near the bottom normally serves as a sediiment trap, sediment can be transported great distances from its source. At varying depths, thermoclines occur which can serve as a boundary above which surface-discharged sediment can accumulate forming a layer similar to the nepheloid layer, but in mid water. A thermocline may result in transport of sediments over a broad area as the particles would be unable to escape quickly and settle to a position of relative immobility on the bottom. Even the shunting of sediments to the nepheloid layer does not prevent biological transport into shallow waters. Benthic filter and deposit feeders may translocate such materials into the water column via gametes or larvae which may introduce substantial volumes of toxic and bioaccumulable substances into food webs when they or their feces are eaten by predators and scavengers.

Evidence from the monitoring studies at the Banks indicates that the limited drilling which has occurred near the reefs has produced no observable impacts on the behavior of reef organisms. These studies are limited, however, because they have relied primarily on sight observations with only minimal use of bioassay and chemical analysis.

The effect of sedimentation on coral reefs and other Bank resources depends on is the dilution and dispersion rate of the effluent after it leaves the discharge point. It is well known that, although healthy corals can cleanse themselves, a weakened coral or one subject to a high rate of sedimentation may not be able to cleanse itself and tissue damage or death may result. A NOAA-supported study of coral reefs in Puerto Rico suggests that turbidity and sedimentation have caused reduction in coral diversity and living cover on the reef. Since the Flower Garden Banks are at the very northern edge of the distribution of Caribbean coral, their communities are especially likely to be susceptible to any environmental change which either lowers their energy income or increases energy outflow. Since sediment removal requires energy which otherwise might be allocated to growth and reproduction, and is accompanied by decreased nutritive input from zooxanthellar photosynthesis and feeding on zooplankton, corals at the Flower Gardens would be seriously threatened by discharges of sediments. These effects will be even more serious if sediments impacting them are toxic.

Studies have indicated that whole lignosulfonate-type drilling muds adversely affect corals and other benthic organisms. A laboratory study conducted at Texas A&M University (Thompson and Bright, 1977) showed that the three dominant Flower Garden coral species were unable to remove used whole drilling fluids, which caused substantial mortalities in all species tested. An EPA flow-through infaunal community develo-ment study revealed that exposure to drilling mud reduced the number of settling macrobenthic infaunal individuals by 72%; the number of sea anemones (close relatives of corals) was 93% lower than controls (Tagatz et al., in press).

Several constituents of drilling muds are known to be toxic and/or bioaccumulable in marine organisms and their discharge is of concern. Barium sulfate is the primary solid constituent of many drilling muds. It is supposedly insoluble, and historically has been considered to be harmless (Sheen Technical Subcommittee, 1976). However, this opinion does not account for the activities of marine sulfate-reducing bacteria (Postgate, 1965), which may break down barium sulfate, releasing barium ions into the environment. Barium has been shown to bioaccumulate by con-centration factors of 17,000 in phytoplankton, 900 in zooplankton (Lowman et al., 1971) and 150 in fishes (Templeton, 1958). Based in part on this evidence, the National Academy of Sciences (1972) recommended that "concentrations of barium equal to or exceeding 1.0 mg/1 constitute a hazard in the marine environment." Dr. K. Ranga Rao of the University of

West Florida (manscript in preparation) has recently shown experimentally that shrimp in the presence of commercial barite consume large amounts, and incorporate barium into their muscles, hepatopancreas and exoskeletons. The results of a recent laboratory study (Tagatz and Tobia, in press) showed that barium sulfate reduces the number of settling macrobenthic organisms by 58%, and the number of species by 25%. These researchers concluded that "although it appears to be relatively nontoxic to many organisms, barite, in large amounts as discharged in offshore drilling, could adversely affect the colonization of various substrata by benthic organisms."

Barium may be a potential problem from the standpoint of bioaccumulation and chronic toxicity in marine organisms. The "barite" used in drilling muds may have a barium sulfate concentration as low as 67.7% (Grantham and Sloan, 1975), and strontium sulfate may be important constituent of the mud grade barite (Shell and Hilton, 1968).

Chromium is another heavy metal that may be released in large amounts into the marine environment as a result of discharging drilling muds. Sources of chromium in drilling fluids include chrome lignosulfonate and ferrochrome lignosulfonate, which are commonly added to control viscosity when drilling deeper than 2500 feet (Sheen Technical Subcommittee, 1976) or where formation temperatures exceed 150° or 200° F (Loy, 1975). Chrome lignosulfonate was present in concentrations up to 15 lb/bbl (= 44, 600 ppm) in several field muds analyses by the petroleum industry

to 15 lb/bbl (=44, 600ppm) in several field muds analysed by the petroleum industry (Sheen Technical Subcommittee, 1976). Preliminary calculations by EPA scientists suggest that the bulk discharge of drilling muds containing these concentrations of this widely used chemical could be toxic to coral many miles from the point of discharge.

EPA has determined a safe level for chromium in fresh and marine waters to be 50 ppb (EPA, 1976). The National Academy of Science (1972) also concluded that 50 ppb is a safe level for ambient marine water, except where oysters are present, where they recommend a limit of 10 ppb chromium. These limits are in part based on evidence that organisms can accumulate chromium from the ambient water to toxic concentrations in their tissues (Lowman et al., 1971).

Concern extends to other heavy metals found in elevated concentrations in bottom sediments after drilling including lead, cadmium and zinc (Holmes and Barnes, 1977). It is speculated that this contamination may have resulted from the discharge of drilling fluids, the use of sacrificial electrolites and the use of lead-based paints on the rig.

The addition of biocides to drilling fluids is a further potential cause of concern. Pentachlorophenol, a commonly used biocide has now been extensively studied (Rao, 1978) with toxic effects in mollusks shown at concentrations as low as 7 ppb (Tagatz et al., 1977). Other biocides used in drilling fluids include other chlorinated phenols, aldehydes, quarternary emines, diamine and heavy metal salts, alkyl phosphates (Thomas, 1978). These and other mud additives cause concern because of the prevalent lack of information about their fate and effects in the environment.

Over 1000 chemical compounds are patented for use in drilling fluids (World Oil, 1977). These include materials to control pH and other ion concentrations, bactericides, calcium resources, conversion inhibitors, defoamers, emulsifiers, filtrate reducers, flocculants, foaming agents, lost circulation materials, lubricants, shale-control inhibitors, surface active agents, thinners, dispersants, viscosifiers and weighting agents (Richards, 1977). The ecological fate of the great majority of these materials have not been studied.

To date there has been no monitoring by industry of bulk discharges of waste or left over muds. In addition to the biological and physical transport questions regarding the dispersal of muds in the water column, there is the question of Chemical Oxygen Demand (COD). The Chemical Oxygen Demand of whole drilling fluids ranges from 15,000 to 41,000 mg/1 (Stanley Assoc. Eng., 1975). Using the latter figure, oxidation of material in a bulk discharge of 800 bbl would completely deplete the oxygen in more than a billion liters of well-oxygenated seawater; such a discharge could reduce by 20% the dissolved oxygen in 12.4 acres of seawater 100 meters deep. A single production platform can produce several hundred times this amount of discharge, hence much greater oxygen depletion.

Evidence cited in Appendix 2 indicates that deep water discharges of drilling effluents around the Flower Garden Banks can result in the sediment movement beyond 1,000 m (3,000 ft) from the discharge point (Continental Shelf Associates, 1978; Marine Technical Consulting Services, 1976). A pre-drilling monitoring report in conjunction with Mobil's exploratory

drilling on tract A-389 indicates that there is a potential upwelling current around the Banks (Continental Shelf Associates, 1975). If bottom currents carry drilling effluent to this upwelling current, drilling effluents could be transported at diluted levels to the live reef areas. McGrail (1978, personal communication), however, strongly discounts the potential for currents to carry sediment up to the reef level and asserts that, even if it were to occur, suspended sediments would be advected away from the reef. Monitoring studies to date support this position.

c. Oil Spills and Blowouts

Hydrocarbon reserves around the Flower Garden Banks are expected to be natural gas. The closest crude oil-production is located about 12 km (6.5 nm) northwest of the West Flower Garden Bank. Quantities of oil however are normally recovered from gas wells so the presence of oil at the Banks cannot be discounted. The potential environmental effects of both oil and gas on the Flower Garden Banks are, therefore, considered.

Few extensive studies assess the impact of petroleum-formed (petrogenic) natural gas on the marine environment. Gas vented into the sea from a producing well or a pipeline rupture would rise rapidly to the sea surface and dissipate into the atmosphere. Soluble fractions would dissolve in the water. Biogenic (i.e., biologically-formed) natural gas seeps have been observed at both the East and West Flower Garden Banks. Oil spills from wells do not appear to be a major environmental hazard to the Banks. Oil spills from tankers may pose problems and are discussed in Section E.4.b., below.

A blowout is the uncontrolled flow of gas, oil, or other fluid from a wellhead which is caused by the rapid release of gas or fluid under high pressure. In the FEIS for Lease Sale 51, BLM states that "in the Texas offshore area the possiblity of blowouts exists due to the presence of shallow gas deposits within sediments. Deeper high pressure gas can also cause blowouts during drilling operation." Since the Flower Garden Banks overlie a known area of shallow gas deposit, the Pleistocene trend stretching perhaps 160 km (87 mi) along the outer edge of the continental shelf, the Banks area may be blowout prone (Martin, 1978, personal communication). Martin (1978, personal communication) estimates that 12 to 15 blowouts have occurred in the Banks area out of the 72 that have been reported for the entire Gulf since 1954 (U.S. Geological Survey, 1978a). Most blowouts are quickly brought under control using safety devices required by the U.S. Geological Survey.

A type of blowout that could be the most devastating, if it were to occur, to the Flower Garden Banks is the type which occurred in March 1977 in High Island Area, South Addition, on block 562 about 64 km (35 nm) west of the Flower Garden Banks. This massive blowout, which was vented from the sea floor, resulted in the loss of the drilling platform, and formed a circular crater 137 m (450 ft.) deep and 490 m (1600 ft.) across (Brooks and Bernard, 1977). After a five month period, seepage of about 11,330 cu m (400,000 cu ft.) per day was still occurring. It is very unlikely, but if a blowout of

this magnitude were to occur within 4 nm upcurrent from the Banks, a tremendous load of sediment, virtually undiluted, could be dumped on the Bank and reef communities and would probably result in a disasterous decline in the reefs. However, the High Island blowout is the largest of its type and fortunately the possibility of occurrence is low. Of the 72 recorded blowouts in the Gulf since 1954 only about 4 have resulted in crater formation (Martin, 1978, personal communication).

It is likely that the gas produced in a blowout would be rapidly dissipated into the atmosphere, but oil components that are vented along with methane will produce a thin oil slick.

The impact of a blowout involving oil would include effects such as those described for oil spills, although a blowout in which oil is vented from the seafloor could generally be more hazardous to biota than a surface spill due to the higher rate in which soluble fractions would enter sea water as the oil floats to the surface. The probability of an oil blowout at the Flower Garden Banks, however, is much less than a gas blowout, because the composition of the resource at the Banks is mostly natural gas.

d. Placement of Platforms and Pipelines

Platforms

The placement of drilling platforms is significant because the structures directly impact the environment and because other polluting activities associated with petroleum development are concentrated there. Since the

effects of activities conducted at the platform are considered above and in Appendix 2, the present discussion concentrates on the direct and indirect impacts resulting from the physical presence of the platforms. All drilling activities (and hence, platforms and mooring of platforms) are prohibited by BLM (in their revised stipulations) on the Banks in areas above the 85 m (280 ft) isobath. The Department of the Interior states that since the living coral reefs are found principally above the 50 m (164 ft) isobath and the most productive hard bank communities, (except the crinoids) lie above this depth, the 85 m isobath defines the biologically productive zone. Restricting the placement of platforms above the 85 m isobath will insure that natural coral reef communities and the shallower segments of the biologically productive zones will not be harmed by the presence of a platform. Well-established hard bank communities, namely crinoids, do however extend below the 85 m isobath down to 100 m (328 ft) or more and represent a transition zone of significance which could be impacted by a platform. Crinoids are feathery invertebrates which have been in existence for 500 million years. Because they are the most significant filter feeders at depths of 100 meters, they play a major role in the functioning of the ecosystem at that depth.

Although platform siting may impact a minute area of benthic habitat, the submerged base of the drilling platform typically acts as an artificial reef which is known to support and attract many types of biota (Rudlow, 1978, personal communication). These include those organisms previously resident and newly introduced transient species which feed off benthic organisms attached to the underwater surfaces of the platform. It is

not presently known whether the new habitat provided by these platforms serves merely to attract fish from surrounding areas or whether these new habitats actually increase the region's overall abundance and diversity. Over time, however, it appears that the platform does provide a vastly more diverse and complex community of attached organisms and fish. If platforms are located close enough to the reefs, species interaction between the coral reefs and the new "artificial habitat" could produce a number of changes in the reef ecosystem. Initially a new platform might attract some of the larger more migratory species away from the coral reefs and thus may alter predation patterns on the reefs. Over time, regional population levels of such species could increase in adjustment to the opportunities afforded by the new habitat. It is possible that several new artificial habitats could result in an increased number of migratory non-resident reef species in the region, increasing predatory pressure on resident reef species.

The higher concentration of pollutants around a drilling platform base could contaminate individual animals, either directly through contact with polluted waters or indirectly through food webs. If contaminated individuals migrate to the coral reef, they could introduce their pollutant load into the reef system. The extent of this problem is the subject of a current BLM funded study (Defenbaugh, 1978, personal communication).

Pipelines

Because of the existing pipeline network existent in the Gulf of Mexico, pipelines probably will be used to transport hydrocarbons to shore. Presently pipelines serve platforms about 12 kilometers (6.5 nm) northwest of the West Flower Garden reef (Blocks A-573 and A-572) and 15 kilometers (8 nm) northeast of the East Flower Garden reef (Blocks A-370 and A-350). Mobil has indicated in its tract A-389 development plan an intent to use pipeline to transport gas to shore (Mobil Oil Corporation, 1978c).

During construction and placement of a pipeline there is a potential for seabed disturbance of bottom sediments, particularly those sediments that may have been shunted to the bottom from the drilling of wells in the area. Bottom disturbance may resuspend muds, cuttings and other materials placing them back in the water column and reexposing them to physical and biological transport. During construction and placement the benthic communities along the route will be disturbed, harmed or destroyed. The areal extent of a pipeline right of way is very small. When a pipeline is buried, the potential for damage to the bottom and resuspension is greater than when the pipeline is simply placed on the bottom. BLM which is responsible for the approval of pipeline right of way on the OCS, requires that pipelines in 200 feet of water or less be buried. Depths in the vicinity of the Flower Garden Banks are greater than 200 feet and, hence, burial would not be required as a routine operation.

3. Recreation

a. General

The principal recreational attractions of the Flower Garden Banks are the regionally unique coral reefs which cap the Bank peaks and the diversity of fish. These reefs attract both recreational scuba divers (who engage in activities including underwater photography, nature study, spear-fishing, and souvenir collecting) and hook and line sports fishermen. The Office of Coastal Zone Management (OCZM) has identified the major recreational activities of potential concern as anchoring, spearfishing, and souvenir/specimen collecting. Recreational issues which have minor impacts include discharges from marine sanitation devices, littering, and hook and line fishing. In the absence of written material on the Bank's recreational use, the analysis presented here is based principally on personal communications with individuals who have been regular visitors to the reef over the past several years.

Although some boats may travel to the Banks for sport fishing purposes, the majority of recreational visitors are scuba divers (Schaefer, 1978, personal communication; Blood, 1978, personal communication; and Pulley, 1978, personal communication). The ports of origin for most recreational boats are Freeport, Houston-Galveston, and Port Arthur, Texas, and Cameron, Louisiana. Peak recreational use periods are July, August, and September when weather conditions are most favorable and leisure time is greatest (Shaefer, 1978, personal communication). During the busiest summer weekends,

four to six recreational boats have been observed anchored over the reefs (Shaefer, 1978 personal communication; Blood, 1978, personal communication). An estimated 50 to 150 boats visit the reef during the course of a year (Blood, 1978, personal communication).

The distance from shore limits recreational usage because the reefs are located 203 km (110 nm) southeast of Galveston. Only the most experienced private recreational boat operators are willing to attempt the trip which takes six to eight hours each way. Private recreational boats at the reef are at least 9 to 10 m (30 to 35 ft.) in length and usually larger. Because of the length of the trip many boats remain at the Banks overnight.

In addition to private recreational boats, one commercial charter boat from Port Arthur, Texas, carries recreational divers to the reefs on a regular basis. Approximately 90% of the recreational divers who visit the reefs do so as paying customers on the charter boat (Blood, 1978, personal communication). The charter boat carries 27 to 40 divers at a cost of about $100 per person. Making between 30 and 40 trips per year, this charter boat carries about 900 divers each year. Because of the 12-hour trip each way (the charter boat is slower than private boats), the boat usually remains at the reef overnight and conducts two or three day dives and one night dive. Although only one charter boat currently visits the reef on a regular basis, a growing demand by recreational divers will likely encourage one or two additional charter boats to initiate regular visits to the Banks in the near future (Blood, 1978, personal communication). The charter boat is 21 m (65 ft) in length and

includes as part of its crew an experienced dive master (Blood, 1978, personal communication).

Recreational boats visiting the reefs for diving purposes seek out the shallowest portions of the reef--usually 18 to 25 m (60 to 80 ft) in depth (Blood, 1978, personal communication). Although the more experienced divers may explore the edge of the reefs in water depths of 30 to 46 m (100 to 150 ft), charter boat divers and probably most divers visiting in private craft tend to limit their divers to 25 m (80 ft.) or less (Blood, 1978, personal communication; Schaefer, 1978, personal communication). Recreational use of the East Flower Garden Banks is considerably heavier than the West Bank due to its shallower depth; Captain Blood indicated that 95% of his trips to the Flower Garden reefs were to the East Bank.

b. Recreational Boat Anchoring

Recreational boats used for both reef fishing and scuba diving anchor directly over the reef. Recreational fishing boats seeking snappers and groupers tend to anchor along the reef margins in water 30 to 36 m (100 to 150 ft) deep since these areas are inhabited by greater numbers of preferred game species (Pulley, 1978, personal communication). Mobil Oil Corporation (1978c), as part of its proposed monitoring plan for development drilling on Lease Block A-389, has included a time lapse camera to be trained on the East reef area to determine the extent to which boats anchor or pass by the reef.

In the process of anchoring, recreational boats usually drop a single anchor which is allowed to plummet to the sea floor. Anchors for private recreational boats such as those found at the Banks range from 9 to 18 kg (20 to 40 lbs) in weight and about 0.5 to 1 m (1.5 to 3 ft) in length. These anchors are about half as wide as long, and are attached either to a chain or a rope with a chain leader. Anchors for the larger charter boats (21 to 30 m or 65 to 100 ft long) are somewhat larger. Once lowered, the anchor is pulled across the bottom until its flukes dig into the substrate. The length of anchor line payed out is usually five times the depth of the water in which the boat is anchored.

Charter boats anchoring over the reef move slowly over coral areas while monitoring their depth finders. When a particular bottom profile is located, a marker buoy is thrown overboard. The captain then moves downwind or downcurrent and returns slowly upcurrent and anchors so that the boat will swing near the marker and over the desired bottom profile. The anchoring process may occur several times before the desired anchorage is located. Both private and charter recreational boats remaining at the reefs for prolonged periods of time (i.e., overnight or longer) often move once or twice to different locations on the reef and thus will repeat the anchoring process. In general, the commercial charter boats, as well as some private recreational boats, attempt to drop anchor in sand flats lying amidst canyon forming reef outcrops. An unknown percentage

of the recreational boats may drop anchor directly onto coral heads. Because of the fragility of aggregate coral formations and individual coral polyps, corals are susceptible to physical damage or injury from ship or buoy anchors. This damage is produced by one of three causes: (1) the actual impact of a dropped anchor as it hits bottom; (2) the intentional dragging of lowered anchors across the bottom to set or raise anchors (anchor dragging may also be caused by natural forces of wind or wave action on the floating boat); and (3) the chafing of anchor chains over the bottom area surrounding set anchors. Of these three causes, the latter two are likely to create the largest impact since they will inflict their damage over the greatest area. Each of these can fracture or overturn coral formations, scrape attached organisms from solid surfaces, and lacerate living tissue. Highly visible anchor scars also detract from the reefs' aesthetic appeal for recreational divers. Because of the slow growth rate of corals, those damaged by anchors or anchor lines have a slow recovery rate. Thus, anchor damage produces long-term cumulative impacts that are significant.

Bright and Rezak (1976), in conjunction with a reconnaissance survey of the Banks reported localized sites of mechanical damage in the live coral and algae-sponge zones at the East Flower Bank during most of their submarine observational dives. Attributing this damage to anchors, they concluded, "It would appear that more actual damage has so far been done to the Bank communities at the East Flower Garden by anchoring and buoy placement than OCS oil and gas drilling activities." Buoy emplace-

ment in this instance was in reference to a buoy observed in 1974 directly on the reef (USCG records indicated this buoy has since been removed). The buoy had too much slack in the mooring cable, causing it to scrape across the bottom and denude to bare rock and sand an area some 30 m (100 ft) in diameter around its mooring block (Bright and Rezak, 1976). Bright and Jaap (unpublished) have also reported scars on the reefs and banks of the West Flower Garden which they attribute to anchor damage. Norse (1978, personal communication) observed several locations at East Flower Garden Bank where anchor damage has apparently occurred.

c. Spearfishing

Spearfishing activity on the Flower Garden Banks appears to be very low. The charter boat out of Port Arthur--which possibly carries 90% of the divers who visit the reef in a year--prohibits its party members to spearfish (Blood, 1978, personal communication). In addition to spearfishing divers, non-spearfishing divers may occasionally carry spear guns for the sole purpose of protection in the event of a shark attack. Visitors on the charter boat, however, are prohibited from diving with spear guns even for protection since sharks are rarely sighted at the reefs. Spearfishing is conducted for sport or for food. The preferred target species are hinds, groupers, jacks and possibly sharks (snappers are rarely found in the shallow diving area) (Blood, 1978, personal communication). The target species generally represent the larger predatory

species on the Banks. In addition to game species, some spearfishermen may also spear slow moving but large species such as parrot fish, trigger fish, and angelfish.

Three types of impacts to Bank resources associated with spearfishing have been identified: (1) effects upon the abundance of species intentionally speared; (2) ecological effects upon the reefal system due to removal of predatory individuals; and (3) effects upon the reefal system incidental to spearfishing activities. Effects upon species abundance depend upon the actual level of spearing and the replacement rate of the fish speared. With the increasing demands of divers who visit the reef, it is expected that spearfishing at the bank will increase in the future, although it should remain low relative to more accessible spearfishing locations. Numerical estimates of the replacement rates of the various target species are unavailable. Most of the larger predatory species are highly mobile and move freely from one area of the Gulf to another. Among the species of fish resident to the Flower Gardens, such as the non-migratory groupers and jewfish, the replacement rates by maturation of juveniles are fairly slow and occur only after the fish have attained a relatively old age and large size. Therefore, the removal of large reef-resident individuals prior to sexual maturity could have significant negative impacts on the overall species population on the Banks.

In addition to reducing the abundance of some target species, the removal of predatory fishes can have an effect upon the overall reef system. Bright and Jaap (unpublished) have suggested that predators remove sick fishes which, if not removed, might increase the incidence of disease in other fishes on the reef. Over-exploitation of predators could therefore result in a population explosion of their smaller prey species or outbreaks of disease which would upset the natural balance of the reef ecosystem.

Finally, spearfishing could produce incidental impacts of potential significance to the reef's resources and use. Spears missing their target may strike corals and thereby damage coral formations. More significant is that spearfishing may condition large fish to fear the presence of divers. This would make it more difficult for non-spearfishing divers to enjoy the presence of these species. Another concern is that fish speared underwater tend to attract sharks which can pose a threat to divers.

d. Souvenir/Specimen Collecting

An activity commonly associated with recreational diving is the selective removal from the sea of a variety of living organisms and non-living marine artifacts. Although this activity is associated with virtually all recreational diving, it is particularly prevalent in coral reef situations because of the abundance of "collectible" items. Souvenir

and specimen collecting includes removal of corals, starfish, shells, sea urchins, sea anemones, small shrimp, feather duster worms, and small brightly colored reef fishes. Removal is typically for display in private homes, as additions to private shell collections, as mementos of an underwater experience, or simply as curios and conversation pieces. Most often the souvenirs collected by recreational divers are small enough to be carried easily underwater and are usually aesthetically pleasing in form and color.

Tropical fish collecting for purposes of display in private marine aquaria is both a popular hobby and a growing commercial enterprise throughout the Gulf of Mexico and adjacent warm water environs. In Florida, for example, the annual value of collected specimens has been estimated $1 million (Bright and Jaap, unpublished). Elsewhere in the Gulf, and throughout the country, a strong market exists for the small, colorful, resident fishes of the coral reef community. The regionally unique nature of the Flower Garden Banks could place an increasing and significant demand on them as a source of aquarium specimens. Some collection of tropical fish has been reported at the Flower Garden Banks, although the number of fish taken is small (Blood, 1978, personal communication).

It is estimated that only a small number of divers at the Flower Garden Banks reefs collect souvenirs in significant quantities (Blood, 1978, personal communication). This is because the majority

of recreational divers visit the Banks on the charter boat and are forbidden by the boat captain from collecting any items except dead shells which can be found lying on the sea floor (Blood, 1978, personal communication). Since the size of the reef is small, a few zealous collectors might seriously deplete the population of certain reef species.

The method of collecting souvenirs (specimens) used by most recreational divers is simply grasping with the hand. A range of other techniques may be employed depending on the objects to be collected and the ambitiousness of the diver. These other techniques might involve a crowbar (to pry up attached corals or shells), a block and tackle to raise large heavy objects, "slurp gun" and butterfly-like nets for capturing small reef fishes alive, and in some instances, fish stunning chemicals such as rotenone (also for collecting live reef fishes). Since recreational divers rarely dive deeper than 25 m (80 ft), collection of souvenirs is limited primarily to the shallower portions of the living reef cap.

The two major areas of concern relative to souvenir/specimen collecting at the Flower Garden Banks are: (1) removal of any corals and other living reef associated animals (particularly the resident species), and (2) damage or injury to non-collected living marine organisms during the process of collection. The general categories of reef animals which are likely subjects of collection by divers include corals, mollusks (shells), fish, and assorted invertebrates.

Although any coral species or formation that catches a diver's eye and imagination could become a target for collection, one of the most significant potential impacts is removal of species found only rarely on the Banks. Of the 18 species of corals which have been identified at the West Flower Garden Bank, five of the species have been identified by Tresslar (1974) as being rare on the Banks (although not necessarily rare in other parts of the Caribbean or Gulf of Mexico). These five include Madradix asperula, Helioceris cucuallata (hat coral), Siderastrae siderea (starlet coral), Oculina spp. (ivory coral), and Colopophyllia amaranthus. The collection of these or any other corals which are rare at the Flower Garden Banks could contribute to their elimination from the Banks. Once removed, repopulation from natural sources is extremely unlikely due to the great distance from the nearest coral reef (Edwards, 1971). The loss of a species of coral from the Banks will reduce diversity and upset the natural ecological relationships between individual species established in this complex community. The removal of coral formations, the reduction in species diversity and abundance, and the increased frequency of damage to corals reduce the reef's aesthetic appeal and diminish its research potential.

Collection of small tropical fishes, shellfish, and other invertebrates will have similar impacts. The collection of infrequently

represented species could contribute to their elimination from the Bank biota, could upset delicately balanced species interactions and relationships, and could reduce the aesthetic appeal of an otherwise more diverse reef.

Among the Bank's small brightly colored reef fishes (Bright and Cashman, 1974) likely to be collected are: the blue tang (Acanthurus coruleus), the gobies (Family Gobiidae), the bluehead (Thalassoma bifasciatum), the damsel fishes (Family Pomacentridae), the butterfly fishes (Family Chaetodontidae), some of the parrotfishes (Family Scaridae), and some of the triggerfishes (Family Balistidae).

Shellfish present in the shallow reef area (less than 100 ft [30 m]) are: the various scallops (Family Malleidae); the Atlantic thorny oyster (Spondylus americanus); the turtle cone (Conus testudinarius); the Mindanao cone (C. mindanus); cowries (Genus Cypraea); the Hawk-wing conch (Strombus raninus); the brown-lined latirus (Latirus infundibulum); and the Atlantic hairy triton (Cymtium Pileare) (Lipka, 1974).

Collectors might also gather invertebrate Bank species such as: the brittle stars (order Ophiurida); sea urchins (Family Echinoidae); the feather duster worm (Hypsicomus elegans); the spiny lobster (Panulirus argus); and the Spanish lobster (Scyllarides aequinoctialis). The abundance of these species of fish, shellfish, and invertebrates has not been determined with the exception of two lobster species which appear to be rare (Pequegnat and Ray, 1974; Bright and Rezak, 1976).

e. Other Recreation-Associated Issues

Marine Sanitation Devices

Recreational boats visiting the Flower Garden Banks will have marine sanitation devices (MSD) for disposal of human waste. Some boats may be equipped with holding tanks which produce no discharge into the open ocean. Most boats, however, will have flow-through systems which release raw or partially treated sewage directly into the ocean. Currently, most flow-through MSDs treat waste with chlorine but typically lack the ability to reduce pollutants and have questionable disinfection capacity. Release of sewage from most flow-through marine toilets will temporarily reduce water quality in highly localized areas. The effects of MSD discharges--even considering the cumulative effects of several boats anchored over a limited reef area at the same time--should be negligible since the discharges are usually small and infrequent, and since mixing with ocean waters should rapidly dilute pollutants to insignificant concentrations.

The EPA (under the authority of Section 312 of the Federal Water Pollution Control Act) and in cooperation with the U.S. Coast Guard, has been involved in efforts to further reduce pollution from this source by requiring the use of more efficient MSD systems. Under a cooperative arrangement, EPA has set standards of performance (40 CFR Part 140) for MSD systems and the U.S. Coast Guard has established construction procedures and design and construction requirements (33 CFR Part 159). These requirements will eventually apply to all MSD-equipped

U.S. recreational boats visiting the Flower Garden Banks. A complete implementation schedule has been developed by the U.S. Coast Guard and EPA.

Under current EPA and USCG regulations, all MSDs on recreational boats must produce an effluent with no visible floating solids and have a fecal coliform bacteria count not greater than 1,000 per 100 milliliters. In addition to these MSDs, which are classified as "Type I" MSDs, the EPA and USCG are also working toward the development of "Type II" MSDs which would produce a higher quality effluent and "Type III" MSDs which would hold wastes on board until they could be pumped out in port for land-based treatment. As the technology and general availability of the Type II MSDs is developed, and as shore-based Type III pumpout facilities become more common in recreational boat harbors, a schedule for requiring the installation and use of these relatively pollution-free MSDs will be instituted by the USCG for new and existing vessels. Thus, the negligible impacts from MSD discharges should decrease in the future.

Littering and Trash Disposal

Recreationists visiting the Flower Garden Banks typically bring an assortment of food, gear, and other items which, once used at the Bank area, become trash and garbage: beer cans, soda bottles, packaging materials for new diving or fishing gear, plastic bags and wrappers, and food. Many recreationists simply discard such objects overboard rather than stowing them until returning to port.

The impact of this practice is primarily an aesthetic one, although garbage disposal could attract and concentrate sharks over the reefs, affecting the ecosystem and increasing hazards to divers. Discarded trash would be composed of food which degrades rapidly without harm, and inert materials, which may float or sink to the bottom. Some of the inert debris, notably plastics, glass, and metal, may remain in place for many years. Visitors who travel more than a hundred miles out to the Banks often do so to escape briefly the signs and trappings of a man-made environment. The presence of floating or sunken garbage left by other recreationists can impinge upon the aesthetic quality and thereby reduce the site's enjoyment and recreational value.

4. Commercial Shipping

a. General

The area surrounding the Flower Garden Banks is transited by commercial cargo-carrying vessels using the Texas coast ports of Brownsville, Beaumont, Freeport, Orange, Corpus Christi, Houston, Galveston, Port Isabel, Lavaca, Point Comfort, Texas City, Port Arthur, and Sabine Pass Harbor (see Figure E-1). Houston and Corpus Christi are the third and ninth largest ports in the United States. The Naval Ocean Surveillance Information Center (NOSIC) reviewed the level of ship traffic in the Gulf of Mexico within 30 nm of the Banks for the period January-June 1978. This review indicated that the shipping fairway which skirts the southern extreme of the West Bank is significantly traveled. Also in the review twenty

ships were identified: ten tankers, of which five were U.S. flags; five drill ships, all U.S.; three foreign flag cargo vessels; and two foreign flag bulk carriers. There are insufficient data for specification of the exact number of ships in the area because the above figures do not include small pleasure and commercial craft, coastal commercial craft, fishing trawlers and other vessels not covered by NOSIC surveillance systems. Threats from commercial shipping could result from: 1) the routine disposal of oily and other wastes; 2) anchoring; 3) groundings by large vessels; and 4) the disposal of solid wastes.

The Banks are close to a shipping safety fairway established by the Corps of Engineers (see Figure E-6). Fixed structures cannot be placed in safety fairways; use by commercial vessel traffic is recommended, but not mandatory. The most important fairway with respect to the Flower Garden Banks is the east-west "Gulf Safety Fairway" located only 11 km (6 nm) south of the West Flower Garden Bank. This fairway leads directly to Corpus Christi, Texas, and also connects with other fairways servicing all major Texas and Louisiana ports. One of these connecting fairways is located approximately 65 km (35 nm) west of the West Flower Garden Bank and another is located about 83 km (45 nm) east of the East Bank (Figure E-6).

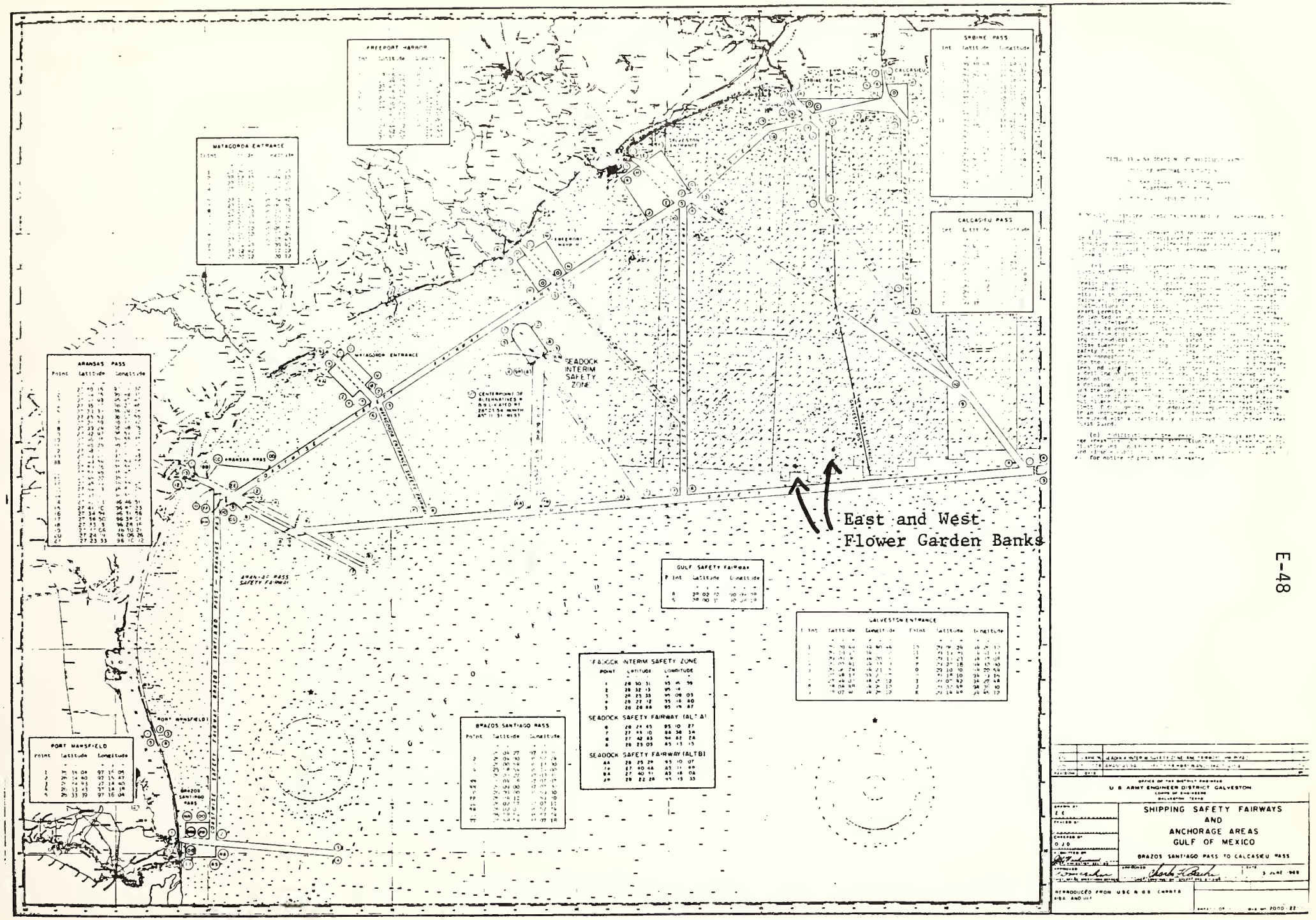


Figure E-6. Gulf Safety Fairway and its position relative to the Flower Garden Banks

According to additional traffic pattern information supplied by the Naval Ocean Surveillance Information Center (NOSIC, 1978), most of the vessels which pass close to the Banks are following the Gulf Safety Fairway. The traffic patterns plotted by NOSIC show most of these vessels are traveling between Corpus Christi and other U.S. ports. Domestic trade involving Lavaca, Point Comfort, and Freeport provides the remainder of the commercial vessel traffic which passes in the vicinity of the Flower Garden Banks. Based on the Corps of Engineers statistics for 1976 (U.S. Army Corps of Engineers, 1976), approximatey 25 percent of 13.2 million metric tons (14.5 million short tons) of the freight received at or shipped from Corpus Christi, Lavaca, Point Comfort, and Freeport were in vessels which used the Gulf Safety Fairway. Corps of Engineers statistics for the period 1967-1976 show a constant increase in overall freight traffic for almost all Texas ports. Data provided by the Coast Guard (Laburn, 1978, personal communication) for parts of 1977 and 1978 show that this trend is continuing.

The major commodity on these vessels, about 78% of the total tonnage, is refined petroleum products--gasoline, jet fuel, kerosene, distillate fuel oil, residual fuel oil, and naphtha petroleum solvents. Crude petroleum made up approximately 14% of the total, while products which as sodium hydroxide, benzene, toluene, basic chemicals, and crude tar made up the rest.

Tankers carry most of this cargo, although barges are also used. The tankers are primarily small, less than 80,000 deadweight tons (DWT), with drafts less than 12 m (40 ft). A few supertankers conduct lightering operations (an offshore activity in which deep draft vessels lessen their draft by transferring a portion of their cargo to small shallow draft vessels) and, thus, are able to use Gulf ports. Shallow Texas and Louisiana ports which presently cannot accommodate tankers with drafts in excess of 12 m (40 ft) have discouraged a trend towards supertankers in the Gulf.

This situation may be altered significantly if plans for two offshore deepwater ports are implemented. An amended application to construct an offshore deepwater port--Seadock--37 to 46 km (20 to 25 nm) offshore Galveston and Freeport has been presented by the State of Texas, and is being reviewed by the U.S. Department of Transportation's Office of Deepwater Ports (U.S. Coast Guard, 1977). Completion of the project is expected in 1984. Construction of a second offshore port--the LOOP deepwater port off Louisiana--has already begun and is scheduled for completion in 1980 (U.S. Coast Guard, 1976b).

Other developments which will increase deep draft commercial shipping activity in the Gulf include the expanded use of lightering, proposals to deepen the ports at Galveston and Corpus Christi to depths of 15 m (50 ft) and 23 m (76 ft), respectively, and the Strategic Petroleum Reserve Program for the Gulf coast states. Thus, commercial

shipping activity in general, and deep draft vessel traffic in particular, will probably increase in the coming years in the western Gulf of Mexico.

b. Routine Disposal of Oily and Other Wastes

Intentional discharges of oil and other hazardous substances during routine tanker maintenance operations are potentially major threats to coral reef resources. The discharges of concern include deballasting, tank washing, and bilge pumping. Knight (1978) estimates that worldwide these discharges account for as much as 75% of all oil pollution from vessels while the U.S. Coast Guard (1976a) estimates that 45.8% of all oil entering the marine environment comes from vessel transport of petroleum. The frequency of discharges near the Flower Garden Banks is unknown.

Deballasting involves the disposal of water by a tanker prior to its arrival at port. This water, which is carried on the non-cargo, or ballast, leg of a voyage for propeller immersion and stability will, upon discharge, contain quantities of the tanker's previous cargo. Only if the tanker contains tanks devoted solely to carrying ballast water--segregated ballast tanks (SBT),--will the discharge be uncontaminated. Tank washing, as the name implies, involves the cleaning of a tank after its cargo has been unloaded. Such operations are conducted 1) to obtain cleaner ballast water; 2) for inspection and maintenance purposes; 3) before a new product is taken on; and 4) to reduce sludge build-up. The ocean discharge following tank cleaning will contain some quantity of the substance which the tank had previously held. Use of SBT and a procedure called load on top (LOT),

which holds tank cleaning water long enough for oil or other cargo to float to the surface where it can be skimmed off and retained prior to waste water discharge, will reduce the amount of oil or other hazardous substance discharged. The washing of tanks after offloading with crude oil, rather than water, will also reduce the discharge from oil tankers which are equipped to perform such operations.

Bilge pumping is conducted periodically by tankers to remove the oil and waste water which collects in bilges from leaking pipes and machinery. On some ships, the amount of oil discharged is reduced by allowing the oil to separate naturally out of the oil/water mixture, or by using oil-water separators.

Estimates of the amounts of oil discharged by oil tankers of different sizes and equipped with various pollution control technologies are included in Table E-1. The levels of discharges from tankers carrying substances other than oil would be similar, varying slightly with the degree of clingage to the tanks holding the cargo.

While the frequency of tanker discharges near the Flower Garden Banks is not currently known, there are reports of tankers specifically seeking out banks such as the Flower Gardens to conduct routine maintenance operations. Crew members not occupied by maintenance

work then have the opportunity to fish (Elvers, 1978, personal communication). Witnesses at the December 16, 1977, hearing on the Flower Garden Banks sanctuary nomination held in Houston (National Oceanic and Atmospheric Administration, 1977) testified that tankers have been observed anchored over the Flower Garden Banks to clean their tanks and pump their bilges. In 1978, a study team, Continental Shelf Associates, while conducting a monitoring study at East Flower Garden Bank, observed a Liberian flag tanker anchored less than one-half mile away (see Section E.4.c, below). Despite these reports, it is still uncertain how common an occurrence this is. Some frequent Bank visitors have not observed such activities (Blood, 1978, personal communication; Shaefer, 1978, personal communication; Pulley 1978, personal communication), but the operations being conducted by an anchored ship may not be readily apparent. Since commercial ships operate under tight schedules in which stopping at sea is discouraged, anchoring over a bank to conduct routine maintenance, which can be done while underway, would not be expected to occur more than occasionally.

Routine oily discharges from ships passing by may also affect the Banks. The discharge of oil and oily mixtures (other than from machinery space bilges) is prohibited by both domestic and international law within 93 km (50 nm) of shore (Oil Pollution Act of 1961, as amended, and 1954 International Convention for the Prevention of Pollution of the Sea by Oil, as amended). As a result, tank washing and ballast dumping cannot be

TABLE E-1. Summary of Operational Oil Discharges (Tons Per Typical Round Trip Voyage). SOURCE: Science Applications, Inc. et al., 1978, Development of Environmental Plan Submitted as Part of the Oil Purchase/Transport Contract, 1978. (Prepared for U. S. Department of Energy)

	Vessel Size (DWT) 35,000		50,000		120,000		200,000		250,000		350,000	
	Max.	Typical	Max.	Typical	Max.	Typical	Max.	Typical	Max.	Typical	Max.	Typical
1. Deballasting of unwashed tanks (non-segrated ballast; not LOT)	21	10	30	14	72	33	120	56	150	70	210	97
2. Deballasting of washed tanks (non-segregated ballast)	6	2	9	3	22	7	36	11	45	14	63	19
3. Deballasting of crude oil washed (with a water rinse) tanks	2	0.7	3	1	7	3	12	4	15	5	21	7
4. Deballasting of segregated ballast[A]	0	0	0	0	0	0	0	0	0	0	0	0
5. Tank water clean- (non-segregated ballast, not LOT)	113	76	162	109	388	261	648	435	810	543	1134	760
6. Tank water cleaning (LOT)	34	15	49	22	117	52	194	87	243	109	340	152
7. Tank water cleaning (LOT & segregated ballast)	17	7	24	11	58	26	97	43	122	53	170	75
8. Tank crude oil washing with a water rinse (LOT)	6	3	9	4	22	10	36	17	45	21	62	29
9. Sludge Removal[AA]	-	14	-	20	-	48	-	80	-	100	-	140

10. Bilge pumping (varies only slightly with vessel sizes)
    a. Direct discharge overboard max: 3 tons/voyage; typical: 2.5 tons/voyage
    b. Use of oil/water separator max: 1 ton/voyage; typical: neg.
    c. Discharge from setting tank max: 2 tons/voyage; typical: 1.5 tons/voyage

[A] It is assumed that all vessels have adequate segregated ballast for all ballast voyages.

[AA] The performance of this operation at sea is being phased out.

performed unless an oil tanker is farther than 93 km (50 nm) from shore. The Flower Garden Banks' location--203 km (110 nm) offshore and 11 km (6 nm) from a major shipping fairway, places them in the general area where these oil tanker operations take place.

The severity of oily and chemical discharge impacts on the ecology of the Flower Garden Banks is largely dependent on 1) how close to the Banks the discharge occurs, 2) the quantity discharged, 3) the chemical properties of the discharged substance; and 4) the frequency of discharges.

In general, routine discharges of crude oil might not pose a major threat to the coral reefs because discharged oil would probably be dumped several miles from the reefs and would tend to float over and past the corals without a threat of physical impact. Routine oily waste discharges could, however, raise the concentration of hydrocarbons in the vicinity of the Banks and could thus have greater impact than OCS oil and gas development oil spills. If the tanker discharges are refined petroleum products, the impacts could be severely damaging since some components of products such as fuel oil, distillates and kerosene are much more toxic and soluable than crude oils.

As the distance between the discharge and the reef increases, the potential for impacts correspondingly decreases due to weathering, dispersion and dilution. Refined oils, chemicals, and crude oils tend to change composition rapidly once exposed to air and the action of waves and currents. Freshly spilled oils contain higher levels of more toxic

aromatics and other components than do weathered oils. Some of the toxic components, although not all, tend to evaporate or be degraded by bacteria within days or hours of disposal. Some toxic fractions, low boiling saturated and low boiling aromatic hydrocarbons (Hufford, 1971), are readily soluble in the water column.

The chemical effects of oil and chemical discharges could be experienced by both individual reef animals and the entire Flower Garden Banks ecosystem. Chronic chemical exposure can interfere with the complex array of behavioral and chemical interactions which take place within the environment. Self-perpetuating activities such as feeding and reproduction could be affected. At the ecosystem level, the chemical impacts induced by oily and other intentionally discharged wastes could short-circuit many vital pathways. The wastes could alter food webs, migration patterns, symbiotic relationships, and many other inter-specific dependencies.

c. Anchoring by Commercial Vessels

Anchoring by commercial vessels is a concern both because of the direct damage that can be done by massive ship anchors and because of the opportunity afforded vessels to engage in polluting activities close to or over the coral reefs while anchored. Although some frequent visitors to the Banks have not observed ships anchored there, others have.

Dr. Thomas Bright of Texas A&M University testified at the public meeting in Houston (December 16, 1977) on the proposed designation of the Flower Garden Banks as a marine sanctuary (National Oceanic and Atmospheric Administration, 1977) that "(t)here are repeated reports of large ships anchoring on the Flower Gardens. We have seen them out there ourselves." During the same hearing Congressman Bob Eckhardt (D., Texas) claimed that tankers anchoring at the Banks to clean out their bilges were "snatching hunks of live coral from the reefs when their anchors (were) lifted." A report from Continental Shelf Associates (1978), a biological consulting firm doing reef monitoring surveys at the East Flower Garden Bank, reported that a Liberian flag tanker had been seen anchored less than 0.5 mile from CSA reef monitoring site.

Bright and Rezak (1976) have noted, at the East Flower Garden Bank, numerous bottom and coral scars they attribute to anchoring. Based on these operations, they characterized anchoring as one of the most significant human impacts to date on the reefs. The small size of these scars indicates that a large part (probably a vast majority) of anchor damage at the Banks should be attributed to recreational boats.

Vessels providing support for OCS oil and gas operations near the Flower Garden Banks might also seek out the shallower Bank areas to anchor until a platform is in place. After platform placement, they would tie up at the platform.

Ships waiting for berthing facilities to open in busy Gulf coast ports might anchor at the Banks but their great distance from the ports and the presence of designated anchorages in the immediate vicinity to port access channels makes it unlikely that this type vessel would anchor at the Flower Gardens. Ships stopping to conduct lightering operations might seek out shallow banks, of which there are many besides the Flower Gardens. In this instance, however, the operation can be conducted while underway and is almost always done in one of four Gulf areas recommended by the Coast Guard. The lightering area closest to the Flower Garden Banks is approximately 100 k (54 nm) northwest of the West Bank off Galveston, Texas. While the frequency of anchoring by commercial vessels at the Flower Gardens is unknown, the effects of even a few anchorings are likely to be significant. With anchors of 3 m (10 ft) or more in length, exceeding several tons in weight, and attached to heavy anchor chains hundreds of meters long, their raising, lowering, and dragging could have potentially devastating results on localized portions of the coral reef.

In addition to direct physical destruction of coral formations, corals merely scarred or injured may become more susceptible to infection by organisms such as bluegreen algae or reef diseases. The slow growth rates of corals make replacement of destroyed formations a lengthy process involving years. Thus, the incremental impacts of even just a few anchoring episodes, within a two- or three-year period, are cumulatively significant.

Anchoring can also produce several other impacts. Broken, crushed, or overturned corals reduce the aesthetic quality and recreational appeal of the reef. In addition, the physical presence of large cargo vessels anchored at the reef can detract from the recreational value of the site. Destroyed coral formations also result in the loss of a limited area of reef habitat which can affect the reefs' overall productivity and diversity. Finally, if the anchor were to destroy a limited area of reef in which a rare species is found, the damage could contribute to the loss of that species from the reefs' biota.

d. Vessel Traffic

Vessel traffic in the vicinity of the Flower Garden Banks produces a small possibility of a grounding. The general competence of ship captains, the sophisticated navigational equipment on large commercial vessels (such as Loran C), the presence of navigational aids, and navigational charts marking the Banks help reduce this risk. Nevertheless, the fact that drafts for large vessels passing near the Banks in the Gulf Safety Fairway are greater than the depths over the reefs creates some concern.

Bright and Rezak (1976) report that the reeftop of the East Flower Garden Bank varies in depth from 18 to 28 m (59 to 93 ft), but depths of 14 m to 15 m (46 to 49 ft) are common and at least one 11 m (36 ft) depth has been encountered. Bathymetric surveys by Bright and

Pequegnat (1974) indicate that the West Bank is generally deeper than the East Bank. Average depths for the West Bank are slightly less than 26 m (85 ft) with individual coral heads rising to within 16 m to 18 m (52 to 59 ft).

Supertanker with drafts in excess of 18 m (80 ft) could ground on either Bank and even some smaller vessels with a capacity as low as 80,000 DWT and a draft of about 15 m (40 ft) could ground on the East Bank. Although a majority of vessels currently navigating the Gulf of Mexico are 80,000 DWT or less, deep draft vessel traffic in the Gulf and near the Flower Garden Banks is expected to increase significantly in the coming years thus increasing the probability of a grounding

If a tanker grounding occurs at the Banks, drastic physical damage and chemical pollution from spilled cargo could result. A direct strike upon the coral cap could physically crush all coral formations which come in contact with the ship's hull. The area affected would depend on the draft of the vessel, the distance its momentum carries it across the reef (assuming the contact is not simply a glancing blow), and the width of the ship. The slow growth rate of coral combined with the large area that would probably be affected would make the physical damage of great long-term significance to the reef community.

The chemical effects upon the reef resulting from a tanker grounding depend on the type of cargo spilled, the amount spilled, and the point of impact on the reef. Although the type of cargo can vary significantly, crude oil and refined petroleum products are of particular concern due to increasing cargo volume. Gulf coast ports are projected to handle 65% of all U.S. oil imports by 1980 and 80% of all imports by 1990 (U.S. Coast Guard, 1976b). Most of this oil will be transported in supertankers of 275,000 DWT to 500,000 DWT with drafts deep enough to ground on either Bank.

Various domestic and international regulations pertaining to tanker equipment and procedures contribute to reducing the probability of a tanker grounding and resultant spill. Both U.S. Coast Guard regulations (46 CFR Parts 32, 93) and international convention (International Convention for Safety of Life at Sea of 1960) require that commercial ships have the following equipment which helps them detect and avoid shallow ocean areas: 1) electronic deep sea sounding apparatus; 2) marine radar system; 3) gryo-compass; 4) magnetic steering compass at main steering stand; 5) radio direction finder; and 6) maneuvering booklet.

If a grounding should occur, various design requirements, most notably cargo tanker arrangements and size limitations and segregated ballast tanks, may help in preventing the incident from becoming a polluting one.

e. Disposal of Solid Waste

On all vessels, solid wastes are generated and disposed during the course of a voyage. Disposal of trash and sewage from commercial vessels is presently of comparatively minor concern. However, as commercial traffic near the Flower Garden Banks increases over the next few years, so too will the impacts of their disposal of solid wastes which could impair the recreational and aesthetic values of the reefs. Marine sanitation devices are required on commercial vessels under jurisdiction of the United States. The EPA and USCG have established certification procedures and design and construction requirements for MSDs. (33 CFR Part 159).

5. Fishing

a. General

This section addresses the collection of finfish and shellfish by commercial and recreational activities.

The Flower Garden Banks are characterized by a diverse assemblage of finfish and shellfish. The fish found at the Banks are categorized in this discussion as either resident reef or migratory species. The former group includes fish living in permanent association with the reef system, such as the small "tropical fish" often displayed in marine aquaria or the jewfish. The migratory species, such as snapper, may be intimately associated with the Flower Garden Banks while other species, such as the mackerels, are not integral components of the Bank ecosystem. Many

migratory fishes periodically inhabit the reefs, presumably due, in part, to the large forage fish populations at the reefs suitable for food (Bright and Rezak, 1976). Resident reef or migratory species may be caught by commercial or recreational activities.

b. Commercial Fishing

Commercial fishing activity for red and vermilion snappers, groupers, and unspecified finfish has been occurring at Flower Garden Banks since the 1880's (Mobil Oil Corporation, 1978d). Currently, the commercial harvest of finfish is primarily limited to snappers. A Gulf of Mexico snapper boat fleet of 14 to 20 vessels [8 to 21 m (60 to 70 ft)], mostly based in Pensacola, Florida, fishes for snapper with hand lines at Flower Garden Banks and other banks rimming the Gulf. Most of the effort is directed toward the fringe of the coral cap, at about 30 to 50 m (100 to 165 ft), where snapper seem most abundant. These boats apparently do not anchor while fishing.

Snapper are a demersal (bottom dwelling) fish that are collected mostly by hand line (Moore, 1978, personal communication); line fishing by hand would not result in any appreciable physical damage to the reefs. Some gear types which are used in commercial fishing operations elsewhere than at the Flower Garden Banks could damage important bottom formations if used at the Banks. Trawls which consist of netting, wires, weights

and doors and which are at times dragged across the bottom could inflict severe physical damage to live reefs and to supportive life forms in the lower segments of the hard banks. Such damages would resemble those resulting from anchoring. The bottom around the Flower Garden Banks is such rough terrain, however, that there are no trawling operations at the present time and thus, there is no evidence of trawl damage. Shrimp and finfish trawlers do not fish on the Banks for fear of having their nets damaged or snagged. With the advent of new technologies in fishing equipment or the increase of fishing activity, trawling could pose a threat to the Banks if it becomes a viable fishing method. Since life forms on all levels of the Banks are interrelated, bottom trawling in deeper waters could alter the corals at the top. Line fishing, the one technique documented on the Banks, will not inflict any structural damage.

Other commercial fishing in waters deeper than the reefs may affect the reef ecosystem. Benthic and demersal fishes, such as snappers, groupers, and other reef and migratory fish, exert major influences on coral reef energetics and form. Some larger carangids and some species of trigger fish occasionally move or uproot coral during their feeding and nest-building activities (Glynn, Steward and McClosker, 1972). Parrotfish and numerous other fishes feed upon the corals directly (see Randall (1974) for a review of fish predation on coral). Although such

activities are destructive to the reef and the coral, they are part of the intricate ecological relationships of the reef system. Snappers, other demersal finfish, and the benthic crustaceans all may contribute to the amount of detritus in the waters bathing the reef; Lewis (1977) has suggested that detritus could form the base of the coral reef food chain. Much of the detritus could be generated from fish grazing on algae within the live coral and hard bank zones (Hiatt and Strasburg, 1960; Stephenson and Searles, 1960; Randall, 1976). Hobson and Chess (1978) photographed and discussed the activities of planktivorous and detritivorous fishes that feed on assorted biota near a coral reef and then return to the safety of the corals where they defecate particles essential to the diet of coral polyps. A similar nutrient cycle from algae to the corals has been suggested by Lewis (1977) for herbivorous fishes. All feeding and excreting activities contribute to the suspended detritus load that forms the bulk of coral polyp diets. The complex energetics of these interrelationships are discussed in Baka (1966, 1969).

Snappers, which are the only fish supporting a directed fishery at Flower Garden Banks, are not resident reef species. However, some of the bycatch species from snapper boats are residents--groupers, jewfish, and other small species. Removal of a small percentage of their populations could have repercussions in the reproductive capabilities of the species. This may be especially true for populations with relatively low stocks. Resident reef species separated by hundreds of miles from their nearest source of recrutiment in the other coral reefs of the Gulf of Mexico may also be impacted.

Potential fisheries in the Flower Garden Banks vicinity appear to be limited to two species of shrimp. An extensive royal red shrimp ground has been identified by the National Marine Fisheries Service (U.S. Bureau of Land Management, 1978a) along the continental slope 9 to 37 km (5 to 20 nm) south of the Banks. To date, these grounds are not exploited west of the Mississippi River region. A second potential fishery for the Flower Garden Banks area is brown shrimp (Penaeus astecus) which is extending into deeper, continental shelf waters every year (Moore, 1978, personal communication). Finfish species that could possibly support commercial exploitation near the Banks include groupers, jewfish, and tuna (bluefin, yellowfin, blackfin, skipjack).

c. Recreational Fishing

Sport fishing also occurs at the Flower Garden Banks. Although catch and effort statistics for the recreational sector are not available for the Flower Garden region, certain generalizations about the activity may be made based on personal accounts. Sport fishing includes small parties on private boats and large charter boats with as many as several dozen clients (Blood, 1978, personal communication). Both classes of vessel spend one to several days near the reef per trip. The predominant fishing gear is hook and line for both resident (groupers and others) and migratory (snappers, tuna, billfishes, mackerel) species. Recreational fishing may be the sole aim of some boaters or a diversion for divers.

Most of the recreational fishing activity at Flower Garden Banks is centered around the fringes of the coral reef. Snapper are most sought in that zone. Further from the center of the reefs, in deeper fringing waters, billfish (marlin, sailfish, swordfish) are fished for by tournament and sport fishing boats (Blood, 1978, personal communication). The boats usually anchor along the fringes of the reef.

The attractiveness of the Flower Garden region for sport fishing could increase as oil and gas development continues. Placement of a platform near the reef could ease navigation to the site (Mobil Oil Corporation, 1978d). Platforms also offer habitat to fish and emergency assistance to boats in distress (U.S. Bureau of Land Management, 1978a).

The potential level of recreational fishing at the Banks could also increase after designation as a marine sanctuary. Increased public awareness of the resources will likely expand the usage patterns of the Banks.

An increase in recreational fishing activity at the Flower Gardens could contribute to overfishing of the resources, especially if commercial fishing operations occur concurrently. Increased fishing effort from the recreation sector could result in the taking of certain species, particularly resident reef species, in excess of their abilities to repopulate.

6. Research

Specimen Collecting--Manipulative Research--Research Releasing Chemical Pollutants

Three categories of research activities are addressed simultaneously in this section--specimen collection, manipulative research, and research involving the release of chemical pollutants. All three types of research involve limited impacts upon the environment. Specimen collecting is defined in this discussion as the scientific collection of a limited number of individuals or materials for research purposes. The effort could be a one-time-only survey or repeated as needed, for example, to collect specimens for commercial marine aquaria. Manipulative research encompasses *in situ* studies of the effects of an activity or substance on the reef system, such as removing a predator from the food web or testing the effects of drill mud components on coral polyps. Research that involves releasing chemicals directly onto the reef relates to most other scientific investigations. Researchers test the effects of various toxicants on the reef biota to ascertain which substance will allow collection of a particular type of animal while not harming the rest of the community.

The appeal of Flower Garden Banks as a research site is well documented. The Banks represent the northwesternmost coral reef systems in the Gulf of Mexico. Because of their geographic isolation, the Banks support faunal and floral communities that are equally atypical in the region (Hildebrand *et al.*, 1964). Furthermore, the development of the

reef atop a salt dome on the Outer Continental Shelf differentiates Flower Garden Banks from the near shore, shallow waters reefs off Florida or the patch reefs off North Carolina. East and West Flower Garden Banks also differ significantly from each other (Bright and Rezak, 1976); the former Bank possesses leafy algal and Madracis zones that are absent at West Flower Gardens. Lastly, the 203 km (110 mn) distance of the reefs offshore has limited the effects of recreational, commercial, or industrial activities on the ecosystem. When combined, these factors emphasize the importance of the reef to the natural environment and the scientific community.

For the past 25 years, the Flower Garden Banks have been studied by a variety of scientific expeditions. Many of the earlier investigators discussed, listed or pictured characteristics of the fauna (Parker and Curray, 1956; Pulley, 1963; Pierce, 1967; Bright and Pequegnat, 1974; Bright and Rezak, 1976), the bathymetry (Parker and Curray, 1956; Bright and Rezak 1976) or the geology (Stetson, 1953; Lavert and Ferguson, 1969; Edwards, 1971; Bright and Rezak, 1976) of the Banks. Since about 1970, research efforts have been intensified on geological studies to assess the possibilities of oil and gas reserves near the salt dome structure and general environmental surveys of potential drilling areas. The biota of West Flower Garden was studied in great depth by the Flower Garden Ocean Research Center, a now defunct section of the Marine Biomedical Institute of the University of Texas Medical Branch at Galveston, and published as a separate book (Bright and Pequegnat, 1974).

The current thrust of research efforts at Flower Garden Banks reflects the involvement of oil and gas companies. As specified by 30 CFR 250.34 and outlined in the Federal Register (Volume 43, number 19) on January 27, 1978, an "environmental report" that is part of a "development/production plan" must be prepared prior to any drilling activity. In the Flower Garden vicinity, Mobil Oil Corporation (1978d) and Cities Service Company, et al. (1978) have completed environmental reports of block A-389 (East Bank) and A-355/356 (West Bank). Mobil Oil and Union Oil may prepare reports for blocks A-379 and A-384 in the near future.

In addition to research sponsored by the petroleum industry, six other projects are in progress or being considered. First, the Ocean Programs Branch of the U.S. Environmental Protection Agency (EPA), through their office in Washington, D.C. and the regional laboratory at Gulf Breeze, Florida, is contemplating a cooperative research program with the National Oceanic and Atmospheric Administration and industry to assess the short- and long-term changes in community structure on the Banks. This study would aim to detect seasonal and annual changes that result from natural cycles or commercial endeavors. The work may involve implanting oceanographic data buoys on the Banks to continually monitor parameters such as current velocity, light penetration, and conductivity, among others. Researchers at Texas A&M University recently received a grant from the EPA to study the physiological effects of environmental factors on corals at Flower Garden Banks. Their research will concentrate on the effects of drill muds, suspended materials, and turbidity upon corals in the field and laboratory.

A different research team at Texas A&M University is presently studying dye diffusion, mixing, surface drift, and related physical parameters at East Flower Garden Bank (McGrail, 1978, personal communication). An electromagnetic current meter has been placed near the crown of the coral zone.

A fourth project has been conducted in tract A-364 north of East Flower Garden. Continental Shelf Associates has studied the effects of discharging drill effluents at the surface during exploratory drilling. The work is sponsored by American Natural Gas, owners of the lease (Gettleson, 1978, personal communication). In another project, BLM issued a permit on August 8, 1978, (valid for one year) for Texas A&M to collect up to 2 kg (4.4 lbs) of corals for use in ecology, geology, hydrography, and chemical oceanography studies at the Banks sponsored by BLM, NOAA, National Science Foundation, and other agencies (Adams, 1978, personal communication). Under another one-year BLM permit that expired October 27, 1978, Texas A&M collected about 45 kg (100 lbs) of corals from East Flower Garden Bank for use in laboratory bioassays designed to examine the effects of drilling muds and mud components on corals (Adams, 1978, personal communication.)

The specific activities associated with each kind of research vary in impact. Collecting flora and fauna may affect the ecological or physical characteristics of the Banks in a manner similar to the effect caused by souvenir collection. Manipulative research is designed to alter

the reef in some manner and then monitor the results. For example, to determine the effects of fish grazing upon the reef, a cage may be placed over a few selected heads of coral or a section of the algal zone. Research utilizing chemicals is a special class of manipulative research. Toxicants are usually applied directly to the reef to see whether a response occurs and to observe the permanence of that response at the chemical concentrations used. For example, to ease fish collection surveys, divers may inject an aqueous solution of the chemical rotenone into reef caverns. The divers will then note whether adjacent corals or other organisms were affected. Other studies may directly study the long- and short-term effects of rotenone painted directly onto the reef.

The impacts of research efforts upon the reef are related to the types of chemicals used. At reefs off the coasts of Florida, which location is most likely comparable to the situation at Flower Garden Banks, Jaap and Wheaton (1975) studied chemicals that could be used in collection or research operations; quinaldine, tricaine methanesulfonate, rotenone and its derivatives, sodium hypochlorite, and sodium cyanide. Rotenone (marketed commercially under several trade names), sodium cyanide, and quinaldine are on the Department of Health, Education and Welfare's toxic substances list (Fairchild et al., 1977). Rotenone and quinaldine were observed by Jaap and Wheaton to alter the activities and health of reef-corals. Quinaldine is used mostly to stun animals for live-capture while rotenone is used as a toxicant to kill animals. Sodium hypochlorite (household bleach) also stuns many marine animals, including lobsters and fish (Jaap, 1978, personal communication).

It should be noted that several rotenone derivatives, quinaldine, and bleach may be mixed with either alcohol or acetone to prepare the desired concentrations of poison (Jaap, 1978, personal communication); those mixes could be toxic individually, although no mention has been found to the effect.

7. Waste Disposal

Ocean dumping in the Flower Garden Banks vicinity has been restricted to one site designated by the U.S. Environmental Protection Agency (EPA). The ocean dumping site is located about 93 km (50 nm) west southwest of the Flower Garden Banks in depths of about 1000 to 1300 m (3280 to 4250 ft); the water surface area of the rectangular site is about 1090 sq km (240 sq nm). Use of this site was discontinued by EPA in March 1979. Hann, et al. (1976) have summarized ocean dumping activities elsewhere in the Gulf of Mexico.

Incineration activities near the reefs occur at the EPA approved site located approximately 120 km (75 nm) south of Flower Garden Banks. This continental slope location is a 4550 sq km (1000 sq nm) site that overlies about 1400 m (4600 ft) of water. Ocean incineration at this site will be permitted by the EPA until September 15, 1981, [40 CFR 228.12(b)(1)]. The primary type of wastes burned at the site is organochlorides from industry in Texas. For a summary of these incineration activities, consult the impact statement for the site (U.S. Environmental Protection Agency 1976b).

The phasing out of ocean dumping, and the distance of the activities from Flower Garden Banks renders any further discussion of the issue unnecessary. It is improbable that currents or biological transportation (food chains, feeding, bioaccumulation) will ever bring measurable quantities of disposed or burned materials near the Banks. Thus ocean dumping and incinceration are not addressed further.

F. Alternatives and Environmental Consequences

The alternatives considered are:

- The Status Quo;
- The preferred Marine Sanctuary;
- Marine Sanctuary options with differing boundaries, activities and degree of control.

The status quo alternative describes the existing situation with respect to programs and agencies that control activity around the Flower Garden Banks.

The preferred Marine Sanctuary alternative represents a proposed boundary and regulations believed adequate to control those activities OCZM deems harmful or potentially harmful to the reef ecosystem.

Other Marine Sanctuary alternatives, differing from the preferred alternative in size, the types of activities controlled, and the degree of control, are discussed and compared with the preferred Marine Sanctuary alternative.

1. Status Quo

An alternative to a marine sanctuary is to rely on the present legal authorities in effect: a conglomerate instituted by a number of Federal agencies. None of the legal authorities came into being to protect coral reef ecosystems such as the East and West Flower Garden Banks. However, agencies have recognized these coral reefs by insti-

tuting policies and regulations that afford a degree of protection under their statutes. This was done in each case because the action controlled by the respective agency posed some degree of threat to the health and wellbeing of the reefs.

The activities presently controlled and the agencies responsible are: (Note that in many cases there is multiple-agency involvement.)

OCS Oil and Gas Development:

Department of The Interior

- Bureau of Land Management
- United States Geological Survey
- U.S. Fish and Wildlife Service

Environmental Protection Agency

Department of Transportation

- U.S. Coast Guard
- Materials Transportation Bureau

Department of Energy

Interstate Commerce Commission

Army Corps of Engineers

Research/Recreation/Coral Protection/Anchoring

DOI-Bureau of Land Management

Commercial Shipping

Environmental Protection Agency

DOT - U.S. Coast Guard

Fishing

Department of Commerce

Regional Fishery Management Councils

Ocean Dumping and Incineration

Environmental Protection Agency

a. Oil and Gas Development

The basic responsibility for administering mineral exploration and development on the OCS resides with the Department of the Interior, pursuant to the Outer Continental Shelf Lands Act (OCSLA), as amended in 1978 (43 USC §1801 et seq.).

The Department of the Interior's Bureau of Land Management and U.S. Geological Survey are the operational units responsible for implementing the statute.

The OCSLA provides authority to protect unique or special OCS areas during oil and gas development through special stipulations that apply to leases in the identified areas. These stipulations, unlike regulations, become contractual terms of a signed lease and cannot be unilaterally altered.

A number of stipulations have been applied to oil and gas development in proximity to the Flower Garden Banks designed to protect their resources. Generally these stipulations are less restrictive for leases after December 1, 1978.

Figure F-1 presents a graphic comparison of BLM's pre-December 1, 1978 and post December 1 stipulations; Figure F-2 is a schematic. Each contains a no activity zone starting at the bank midpoints, in which all oil and gas operations including construction of platforms and of pipelines, drilling, and anchoring are prohibited. The pre-December 1 stipulations identify the outer boundary of the no activity zone as the "bank boundary" which is shown in Figure F-3 for the East Flower Garden Bank and F-4 for the West Flower Garden Bank. Note that the boundary is drawn according to a quarter-quarter-quarter system used in the BLM leasing process. The confusion of designating a boundary as "bank boundary" is removed in the post December 1 stipulations where the outer boundary of the no activity zone is the 85 meter isobath.

Another difference between the stipulations is that the pre December 1 stipulations require shunting and monitoring (subject to review by the U.S.G.S. oil and gas area supervisor) from the "bank boundary" to an outer boundary of 3.2 nm; whereas the post December 1 stipulations require shunting and monitoring, only for 1 nm from the 85 meter isobath. In the 1 nm to 3 nm zone shunting is required, but monitoring is discretionary.

Where required, a monitoring program must be submitted as part of a production and development plan and be designed to assess the effects of the operations on the viability of the reef community. Qualified independent scientific personnel are required to conduct the monitoring program and findings are submitted to the Fish and Wildlife Regional Director, Manager of BLM's New Orleans OCS office, and the USGS Area Supervisor.

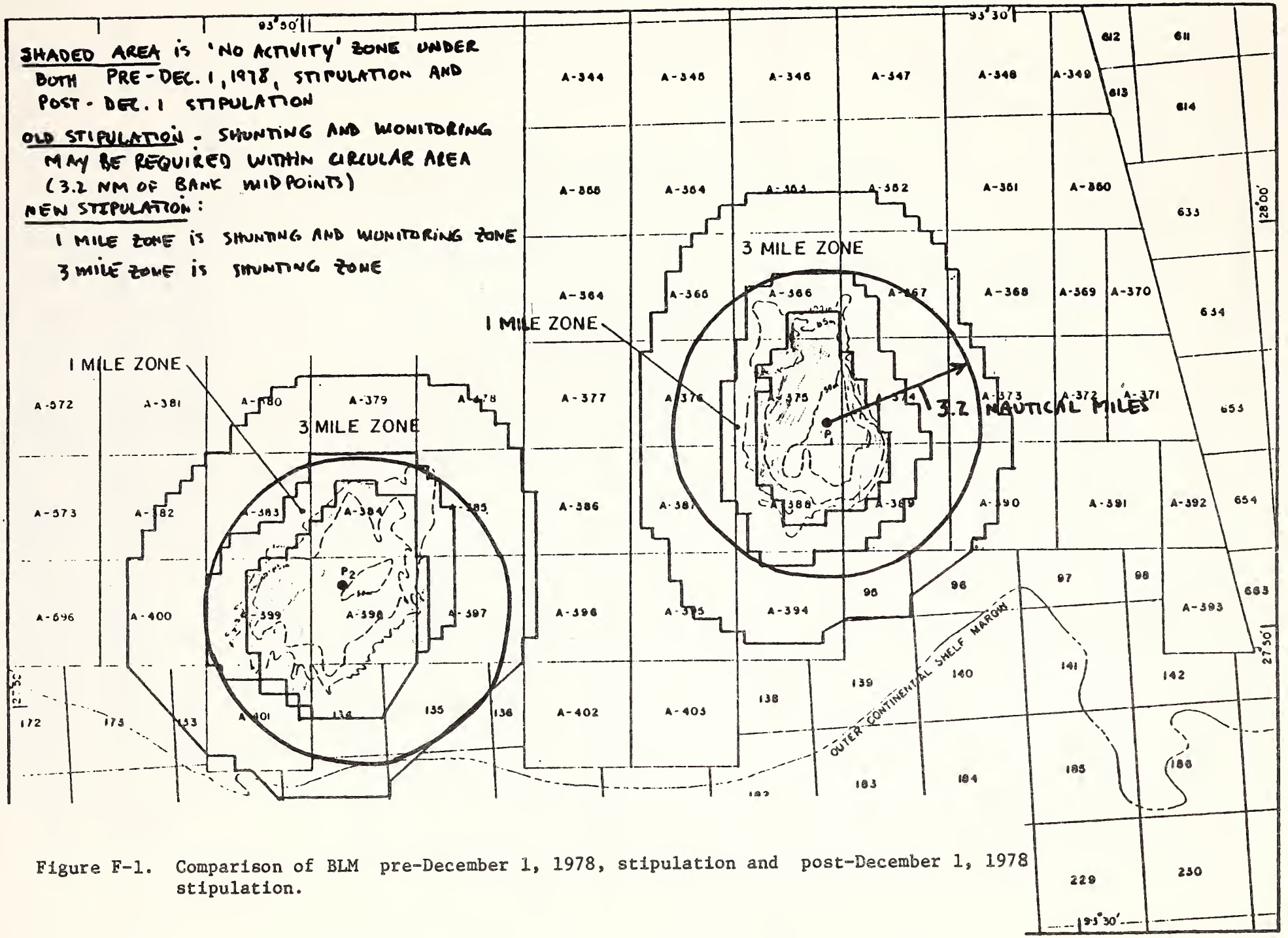
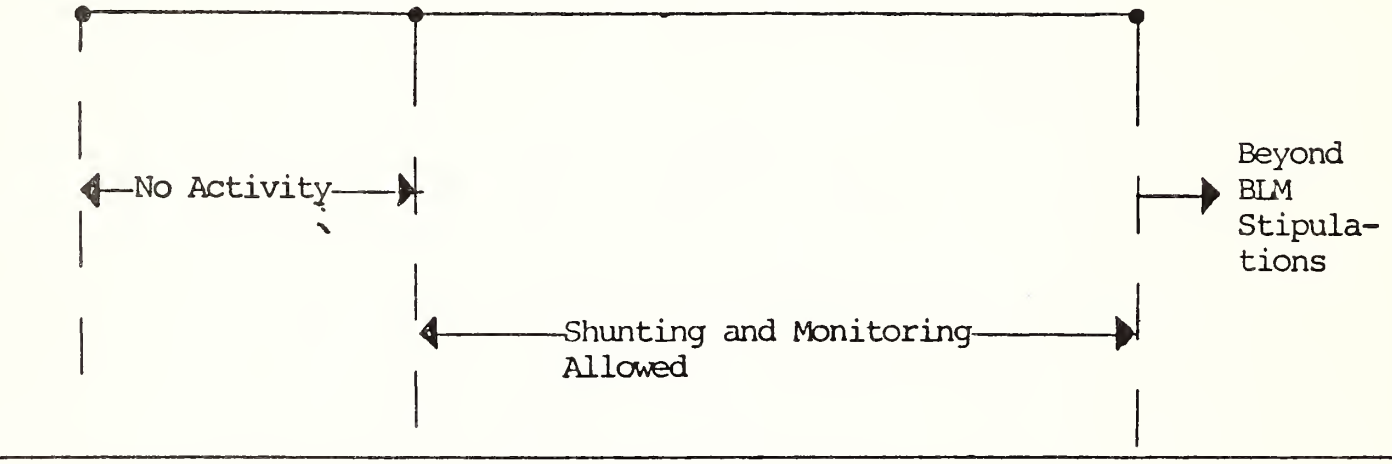


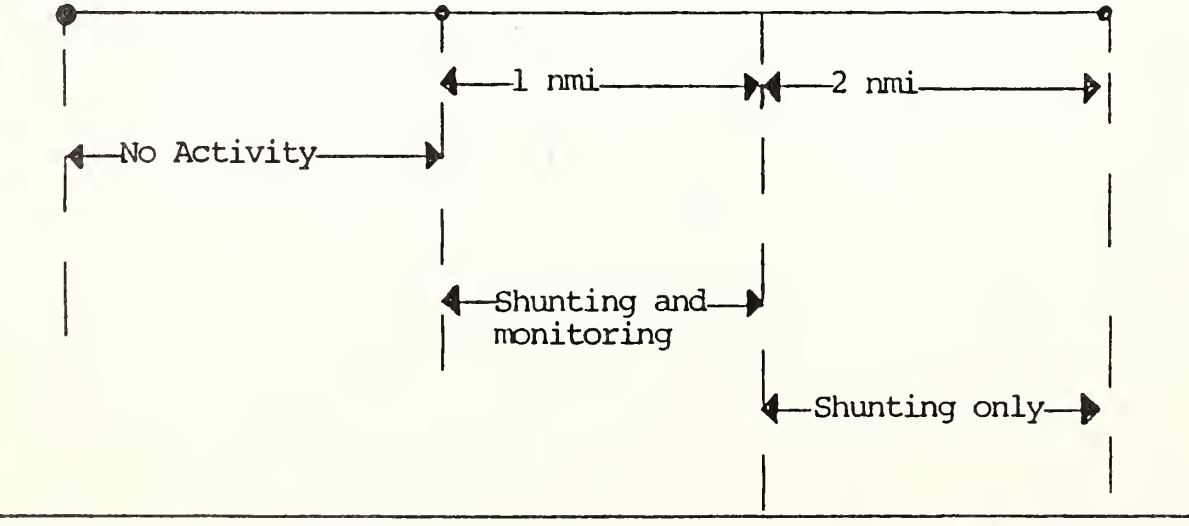
Figure F-1. Comparison of BLM pre-December 1, 1978, stipulation and post-December 1, 1978 stipulation.

Figure F-2. Schematic comparison of BLM pre- and post-December 1, 1978, stipulation

A. BLM pre-December 1, 1978, stipulation.



B. BLM post-December 1, 1978, stipulation.



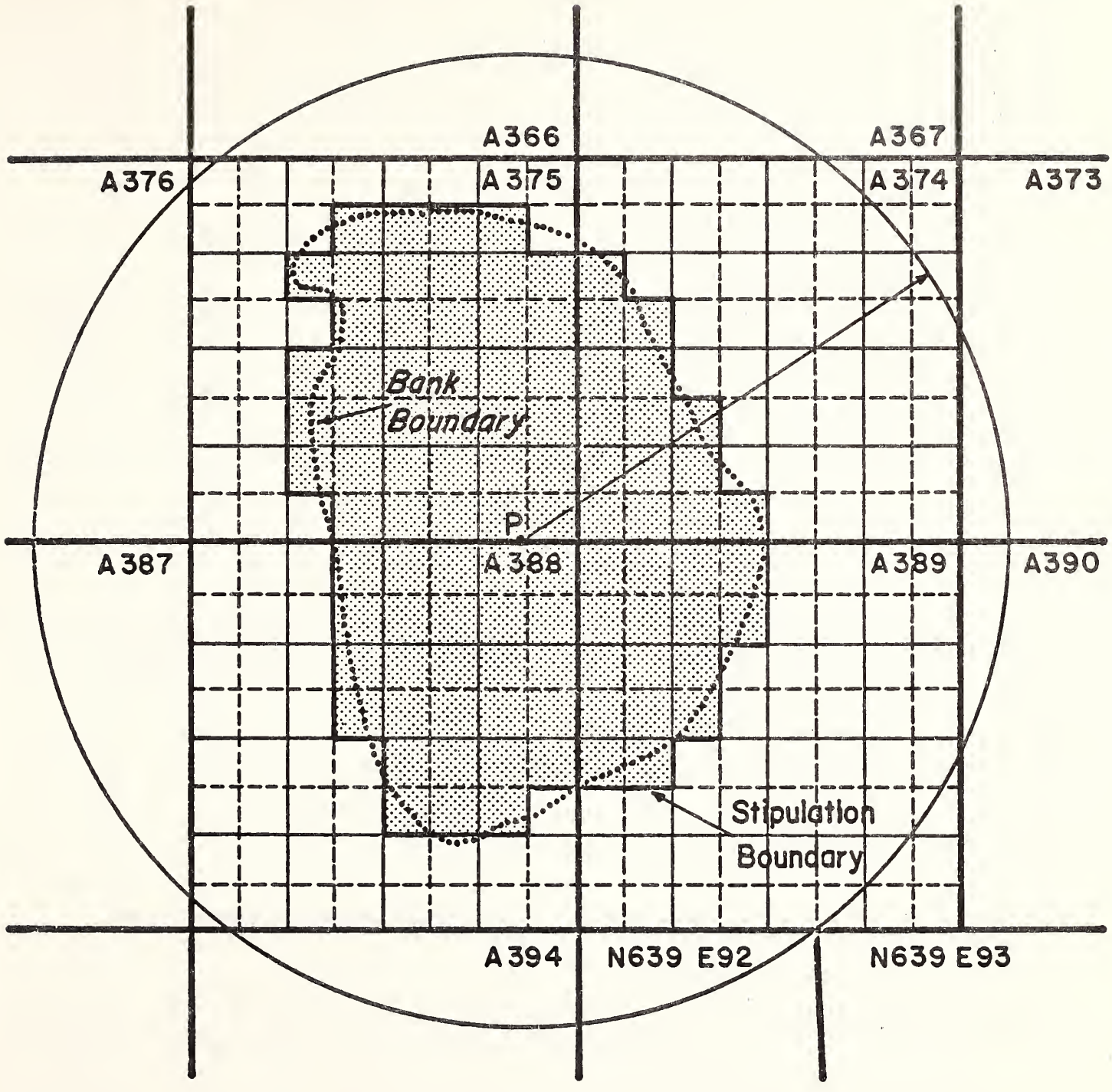


Figure F-3 East Flower Garden Bank Area. Reef building coral is located in the central portion of the shaded area. Development operations, such as drilling, structures, or pipelines are not permitted in shaded areas. Development operations according to Stipulation No. 4 are permitted within the circle (radius = 20,064 feet around point P; located by X = 3,742,875, Y = 71,280; Texas Lambert System). Development operations in the white areas beyond the bank and circular boundaries are outside this stipulated area.

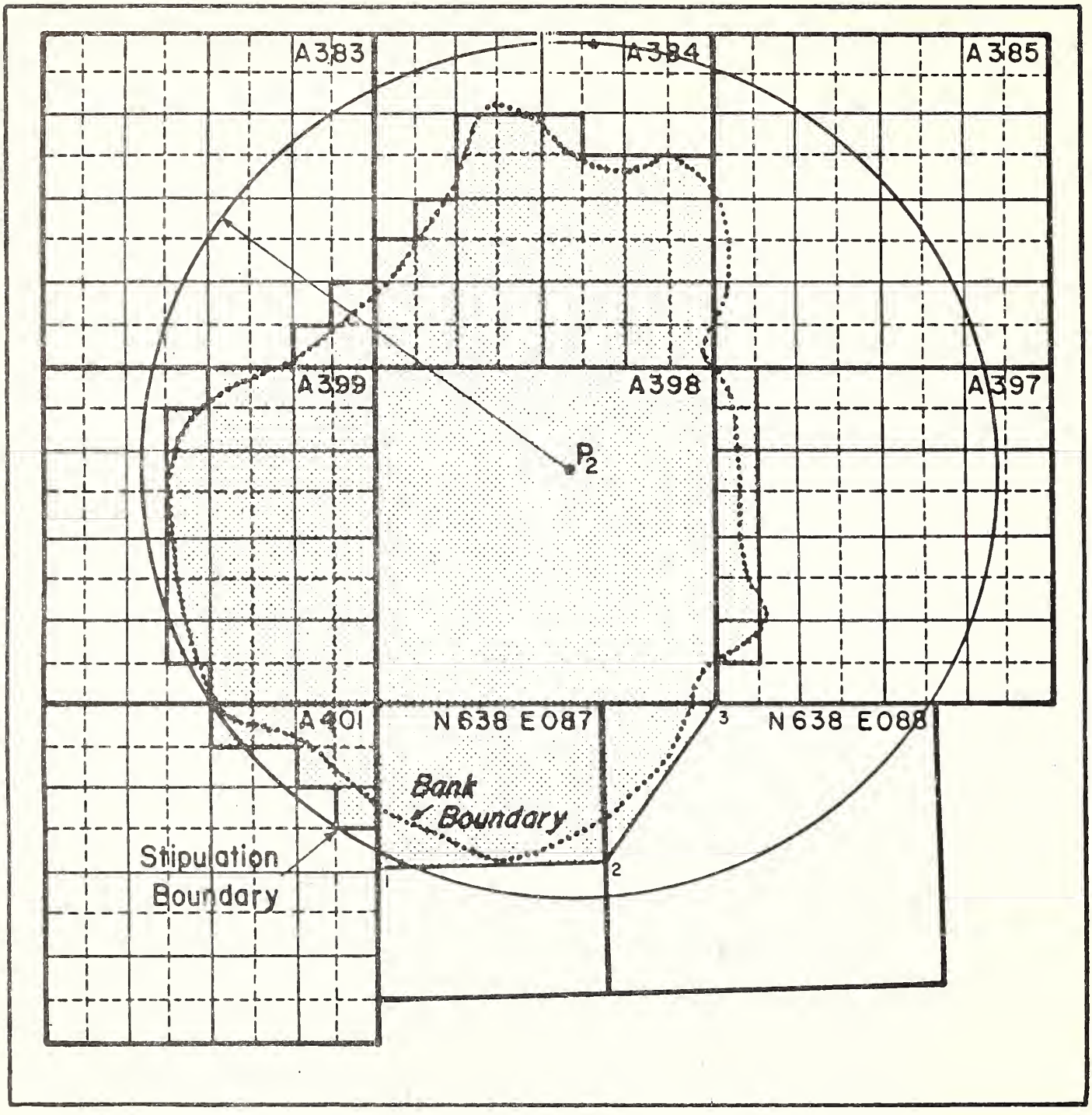


Figure F-4 West Flower Garden Bank, located in the High Island Area, East Addition, South Extension. Reef building coral and other typical reef community organisms are located within the shaded area, and Stipulation No. 2c (see Section IV.D.), if adopted, would prevent development activities (such as drilling, structures, and pipelines) within this area. Stipulation No. 2c would also require shunting and monitoring on all operations which take place outside of this area but within the circle (with radius of 6,116 meters around point P at X = 3,674,965, Y = 50,690; Texas Lambert System). The stipulation would not apply to operations outside the circle. Blocks A385 and A397 are proposed for leasing in this sale.

Figure F-5 illustrates the pre- and post-December 1, 1978 stipulation areas and the lease tracts affected.

Although it has not occurred to-date, if the monitoring program shows that shunting is inadequate to protect the Bank resources, the USGS Area Supervisor may require that the material be transported a minimum of 18.5 km (10 nm) from the 46 m (150 ft) isobath surrounding live reef-building coral to disposal sites approved by the USGS Area Supervisor. Ocean dumping sites must also be approved by the EPA, pursuant to Title I of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 USC § 1401-1444).

In concert with BLM, the USGS is charged with supervising OCS operations and in particular for administering the regulations and stipulations governing lease operations issued pursuant to the OSCLA (30 CFR Part 250). The USGS has supplemented these BLM stipulations by 14 OCS Orders which apply to various aspects of the day-to-day drilling and production operations, including marking of platforms and structures, testing of blowout preventers, content of drilling muds, contingency plans, oil spill pollution equipment, oil spill reports, plugging and abandonment of wells, subsurface safety devices, pollution and waste disposal, and oil and gas pipelines. The USGS is also charged with approving exploratory drilling

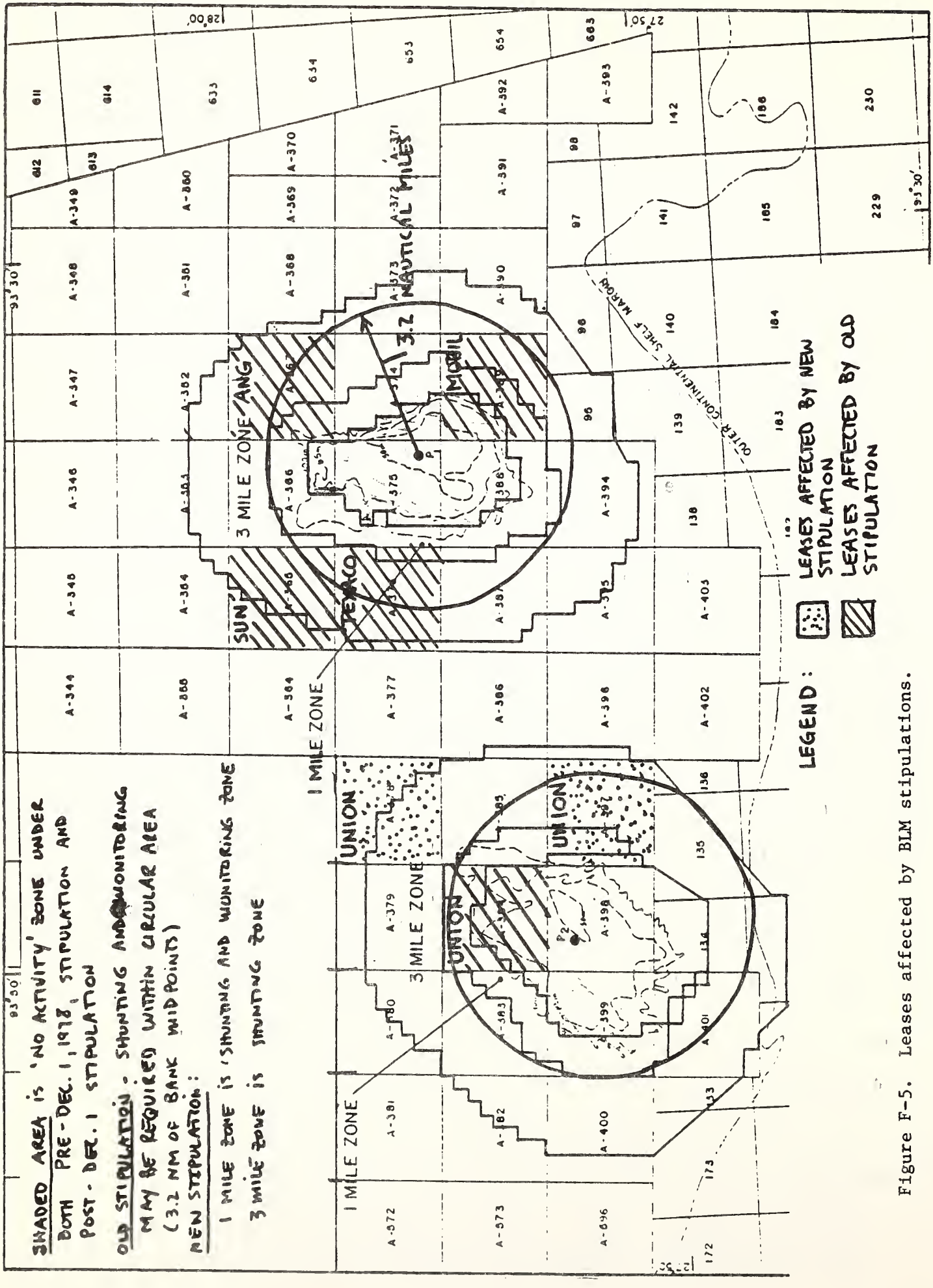


Figure F-5. Leases affected by BLM stipulations.

plans and plans for development, as well as with the responsibility to inspect, monitor, and document the day-to-day activities and operations of the OCS petroleum industry by on-site inspection and tests of safety and pollution control equipment.

Other agencies within DOI - including the Fish and Wildlife Service; National Park Service; and Heritage, Conservation and Recreation Service - are consulted and have input on specific aspects of OCS development (pursuant to Secretarial Order No. 2974 of August, 1978) which includes consultation on stipulations for leases within the vicinity of the Flower Garden Banks.

Disposal of drilling effluents and other wastes from drilling platforms is also subject to control by the Environmental Protection Agency pursuant to Section 402 of the Federal Water Pollution Control Act [33 USC §1343(1976)]. The Act requires that a National Pollutant Discharge Elimintation System (NPDES) permit be obtained to dispose of pollutants or wastes into navigable waters. Permit applications are considered on a case-by-case basis and evaluated in accord with the effluent guidelines and standards shown in Table F-1. Drilling and discharging can occur if EPA either issues a permit or fails to act on a permit application within a specific time period.

Other Federal Agencies (Department of Transportation and Corps of Engineers) also regulate aspects of OCS oil and gas development. The Coast Guard (USCG) of the Department of Transportation must ensure that structures on the OCS are properly marked [OSCLA, 43 USC §1333 (e) and implementing regulations, 33 CFR subchapter C Part 67 (1976)]. Vessels

must comply with USCG certification and inspection regulations whether engaged in drilling activities [46 CFR §2 (1976)] or pipelaying [46 CFR subchapters I, F, J (1976)].

With respect to pipeline construction the Materials Transportation Bureau (MTB), also within the DOT, regulates pipelines safety, pursuant to the Natural Gas Pipeline Safety Act (49 USC 1671-1984); the general design features of pipelines are evaluated by the USCG supervisor, pursuant to OCS Order No. 9. and BLM must grant rights-of-way for pipelines through the Federal OCS. Pipelines linked to interstate commerce are regulated by the Department of Energy (DOE) and the Interstate Commerce Commission (ICC).

Permits to dredge for pipelines (pursuant to Section 404 of the Clean Water Act) must be obtained from The Army Corps of Engineers (COE). The COE also has the responsibility for ensuring, through a permit system, that offshore structures, including pipelines and platforms, will not present an obstruction to navigation [OCSLA, 43 USC §333(f)]. The COE maintains shipping safety fairways by refusing permits for platforms that would be sited in these fairways.

The Federal Energy Regulatory Commission (FERC), within DOE, sets the wellhead price of OCS-produced gas.

TABLE F-1. EPA Effluent Guidelines and Standards for Far Offshore* Oil and Gas Extraction Facilities (40 CFR Pt 435).

Pollutant parameter waste source	Effluent limitations: Oil and Grease — Maximum for any 1 d, milligram per liter	Oil and Grease — Average of daily values for 30 consecutive days shall not exceed, milligram per liter	Residual chlorine, minimum for any 1 d, milligram per liter
Produced Water	72	48	NA
Deck Drainage	72	48	NA
Drilling muds	(1)	(1)	NA
Drill cuttings	(1)	(1)	NA
Well treatment	(1)	(1)	NA
Sanitary:			
M10	NA	NA	1[2]
M9IM[3]	NA	NA	NA
Domestic[3]	NA	NA	NA
Produced sand	(1)	(1)	NA

[1] No discharge of free oil.

[2] Minimum of 1 mg/l and maintained as close to this concentration as possible.

[3] There shall be no floating solids as a result of the discharge of these wastes.

NOTE: M10 means facilities continously manned by ten (10) of more persons. M9IM means facilities continously manned by nine (9) or less persons or intermittently manned by any number of persons.

*beyond 3 nm

b. Recreation.

Recreational activities which might damage the reef system (spear-fishing, souvenir or specimen collection, and diving) and the ancillary activity of boat anchoring are subject in theory to regulation by the by the DOI's Bureau of Land Management under authority of the Outer Continental Shelf Lands Act (43 USC 1334 et seq.) and implementing regulations (43 CFR Part 6224) which provide, "no person shall engage in any operation which directly causes damage or injury to any viable coral community. . .on the outer continental shelf without obtaining a permit. . ." These regulations apply to corals found anywhere on the U. S. continental shelf. Collection of corals at the reefs is clearly prohibited without a permit. Permits have been granted for coral removal for research purposes.

Protection of non-coral but reef associated species is not clear. BLM's coral permit regulations presume to apply to "any viable coral community" defined as, ". . .living coral and all dead coral formations and associated reef organisms that are part of a coral reef or other coral community containing living corals." While the language appears to include non-coral species as well as corals, it has not been tested and the degree to which these non-coral species are subject to the regulations is thus undefined. No permit requests have been filed for non-coral species and no enforcement action has been initiated against an individual for damaging any reef associated species other than a coral (Adams, 1978, personal communication).

Although anchoring has and can markedly damage coral, no permits have been applied for anchoring nor has any enforcement activity by BLM been reported (Adams, 1978, personal communication). The application of existing regulations is thus uncertain.

The Fishery Conservation and Management Act of 1976 created Regional Fishery Management Councils with authority to develop plans and manage fishery resources including corals from the territorial sea to 200 miles from the coast. To clarify authority over coral, negotiations have begun between NOAA and BLM on a draft Memorandum of Understanding (MOU) concerning Federal jurisdiction over this resource. BLM's authority over coral would be transferred on an area-by-area basis to the NMFS upon implementation of a coral fisheries management plan prepared by the appropriate Regional Fisheries Management Council. The plan for the Gulf of Mexico Region (the region in which the Flower Garden Banks are located) is being developed although implementation is unlikely before mid-1980. The draft MOU also proposes to transfer authority over coral to OCZM upon designation of a marine sanctuary and the implementation of coral protection regulations. OCZM's jurisdiction would be limited to those areas within the boundaries of the marine sanctuary.

c. Commercial Shipping

Discharges

Internationally, the 1951 Oil Pollution Convention, as amended, prohibits discharges of oil and oily mixtures within 50 miles of shore and, beyond 50 miles, limits discharges to specified rates and concentrations. Tankers may discharge only when proceeding en route at an instantaneous rate of discharge not exceeding 60 litres (16 gallons) per mile and, on ballast voyages, the total quantity of oil may not exceed 1/15,000 of the tanker's total cargo-carrying capacity. For discharges of ballast, these tests are replaced by the so-called "sheen test"in essence prohibiting any discharge that would leave visual traces of oil on the surface.

Discharges of substances other than oil currently are not covered by international agreement. However, the 1973 IMCO Convention which, in part, will supplant the 1954 Convention will apply to approximately 180 noxious substances when it enters into force. This convention will also add design, equipment and construction standards to provide increased protection against spills resulting from casualties.

Domestically the Oil Pollution Act and section 311 of the Federal Water Pollution Act as amended in 1977 and 1978 control the discharge of oil and other hazardous substances. Generally, beyond the

territorial sea, discharges in connection with OCS and deepwater port activities are prohibited; those discharges which may affect U.S. resources (within 200 miles of shore) are also prohibited except where permitted by the 1954 Oil Convention. However, foreign vessels or persons are subject to civil penalties only if subject to U.S. jurisdiction by virtue of a specific international agreement at the time of discharge.

Currently domestic regulations covering substances other than oil are not in effect. EPA has issued regulations (40 CFR Part 116) listing 271 hazardous substances which cannot be discharged but has been enjoined from enforcing these until they further define what constitutes harmful quantities of each listed substance and establish penalties for violations of the limits. Many of the listed hazardous substances are transported through the Gulf of Mexico. Examples are napthaline, various acids, benzene and liquid fertilizers.

The Port and Tanker Safety Act of 1978, administered by the Coast Guard, authorizes the Coast Guard to control a variety of practices including the discharge of tank washings of oil or hazardous materials by denying port access to the offending vessel.

This Act also authorizes the regulation of design, equipment and construction standards for tankers entering U.S. ports (even in excess of those agreed upon internationally) and mandates a series of standards which include segregated ballast tanks for new tankers and retrofitting of most tankers by 1983.

Anchoring

While BLM's regulations protecting coral communities on the OCS (see section F.1.b) may theoretically extend to harmful anchoring practices by commercial vessels, it has never been applied to such activities.

d. Fishing

The Fishery Conservation and Management Act (FCMA) of 1976 16 U.S.C. 1801 et seq. provides the statutory basis for managing commercial and recreational fisheries. The Gulf Fishery Management Council is empowered to develop and implement fishery management plans that control both domestic and international harvest at the Flower Garden Banks. The Council has initiated development of plans for shrimp, snapper, grouper, coastal migratory pelagic fish, ground fish, coastal herring and associated species, spiny lobster, Atlantic billfish and shark, and coral and coral reef resources (Swingle, 1978, personal communication). The billfish and shark plan will close the Flower Garden Banks to foreign fishing, which will protect both snapper and grouper that normally are caught incidentally to the target species shark.

The fishery management plans, when implemented, may not only specify geographic restrictions on fishing, but may control use of gear such as trawls, in addition to specifying seasons, catch limit, and other terms of operations for commercial and recreational fishing.

e. Research

The taking of samples of coral or conducting research that may injure coral is presently controlled by BLM regulations pursuant to the Outer Continental Shelf Lands Act. The permit program and regulations were discussed previously under Recreation (section F.1.b).

The use of certain chemicals or similar substances on the coral or associated flora and fauna may be subject to the provisions of Section 311 of the Federal Water Pollution Control Act Amendment of 1977. A description of the provisions of this statute and its current applicability is found in the discussion of Commercial Shipping (section F.1.c). Of the chemicals commonly used in research, only sodium cyanide is currently on the list of hazardous substances promulgated by EPA (40 CFR Part 116).

f. Ocean Dumping and Ocean Incineration

Discharges from oil and gas development, commercial shipping, and recreation were discussed previously. Ocean disposal of shoreside wastes is controlled by Title I of the Marine Protection Research and Sanctuaries Act of 1972 which requires EPA to designate ocean dump sites and control their use by a permit program. The Act indicates that Congress intended to phase out ocean dumping and the dumping and incineration at sites in proximity to the reefs will eventually be terminated. Figure F-6 shows the location of the EPA dumping and incineration sites.

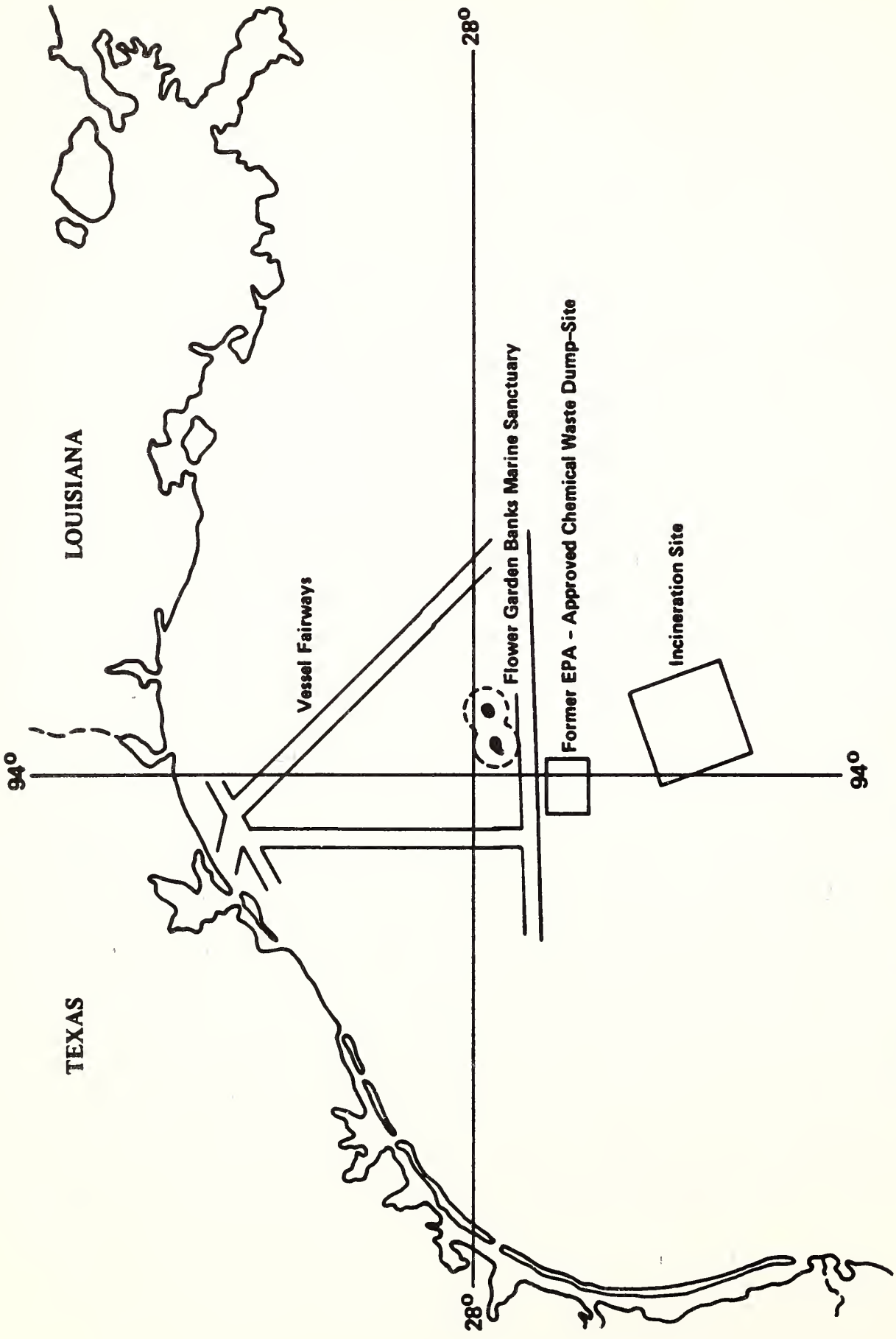


Figure F-6. Location of dumping and incineration sites.

g. Environmental Consequences

Adoption of the status quo alternative would continue to provide some degree of protection to the East and West Flower Garden Banks. However, this protection of the coral reef ecosystem is

- incomplete;
- the incidental effect of statutes enacted for another purpose;
- not the responsibility of a single agency;
- fails to provide for integrated planning and management of resources;
- fails to focus on multiple and cumulative threats to the environment; and
- fails to deal with the long-term impact of uses upon the Banks.

Damage from Pollution

The status quo alternative will leave protection from pollution damages under BLM and EPA authority. Some protection of the reefs from damage due to discharges from oil and gas operations is provided by BLM's lease stipulations and USGS OCS operating orders. However, deficiencies remain. For instance, the important crinoid communities of the reef ecosystem exist beyond the current no activity zone and are not protected. Disposal of drilling effluents is controlled by required shunting; however, shunting may occur too close to the reefs and too far from the bottom to assure that sediment will not be carried in harmful quantities to the living portion of the reefs.

The post-December 1, 1978, BLM stipulations allow the construction of platforms directly adjacent to the 85 meter isobath and require shunting to within 10 meters of the bottom. Therefore, materials from these platforms can be shunted directly onto the crinoid zone. In addition, if the nepheloid layer (which ranges from 1 to 20 meters thick) does not extend to 10 meters from the bottom at the platform, disposal can occur into a water layer that could carry the material close to the living reefs. The fine silt and clay materials characteristic of the discharges could remain suspended for extended periods and be transported considerable distance.

EPA reports that discharges into upper and mid water layers have created plumes more than two miles from the discharge point. In addition, although shunting into the nepheloid layer markedly reduces dispersion of materials, it does not eliminate bioaccumulation of toxins by organisms that contact the material.

Monitoring of disposal of drilling materials is required by BLM but has not been extensive at the reefs nor has data been collected elsewhere in a similar environmental setting. The monitoring requirements fail to provide a continuing or even frequent evaluation of the effects of drilling discharges. Under the present monitoring system there is no real capability of assuring no harm to the reef ecosystem. Damage could occur without any notice depending on the timing of the "during discharges" observations. For instance, there is no requirement that

monitoring occur at the time of bulk discharges of drilling muds, the occasions of perhaps greatest risk. While certain bactericides are banned by BLM near the Banks, the use of other substances, whose effects may not be well documented, does not trigger any special monitoring obligation.

Further, there is no cumulative monitoring system to take account of incremental degradation of the reef resources which may result from discrete drilling operations from different leased tracts. No monitoring for bioaccumulation of toxins is required. Yet the post December 1978 BLM lease stipulations tend to relax the earlier inadequate monitoring requirements.

The NPDES process creates the potential for uncertainty in the oil leasing process and subsequent use of the leases while it increases the degree of environmental protection theoretically available. Tracts can be purchased and when the owner applies for a NPDES permit, at the time drilling is contemplated, the required conditions for operation may be different from the BLM stipulation. At a minimum the guidelines in Table F-1 must be met and additional permit conditions may be imposed. Since the NPDES permit conditions are determined at the time an application is received and permit issued, no distinction is made between old and new leases. EPA has not until recently acted upon applications for NPDES permits for OCS operations in the vicinity of the Flower Garden Banks. Therefore, no predictable protection for this sensitive area has been imposed.

Presumably the bidders for tracts in the vicinity of the East and West Flower Gardens have been aware of the BLM and EPA authorities and the costs associated with compliance and have taken these costs into account during the bidding process. The foregoing conditions, their environmental and economic consequences are treated in more detail in the section on the preferred Marine Sanctuary Alternative.

Besides, BLM and EPA pollution control authorities, present international and domestic regimes control discharges from vessels. While these may be adequate to protect the general marine environment, they are not and cannot be focused upon the particularly fragile and irreplaceable communities of the Flower Garden Banks. No program exists for monitoring the effects of routine vessel discharges.

There is currently no regulation of the damage to the reef ecosystem which attends littering and other refuse disposal at the Banks, other than BLM stipulations prohibiting such activities by vessels engaged in OCS oil and gas activities. Such dumping from all other vessels is unchecked.

Physical Damage to Coral Community

The existing BLM regulations, while theoretically requiring a permit for activities injuring a viable coral community, have never been applied except in relation to permits for the collection of corals for research. Damage from anchoring by recreational or commercial vessels is thus unregulated. BLM does not currently conduct surveillance of activities at

the Banks. No increase in BLM enforcement personnel or resources is foreseen which might alter this situation, and, as recreational use of the reefs increases, the accompanying harm is also likely to escalate.

Protection of coral reef associated species from taking and damage is even less certain presently. BLM has never issued permits or taken enforcement action involving such activities. The very applicability of the current regulations is undefined. The use of chemicals or other potentially destructive mechanisms to collect specimens including tropical fish is likely to continue unabated under present regulation.

Presently, it appears unlikely that the provisions of future fishery management plans (FMPs) could adequately protect the coral reef ecosystem from anchor damage or harm associated with oil and gas activities. While FMPs will undoubtedly reflect a sensitivity to the Banks resources, the focus of these regulations seems likely to remain a species oriented approach to managing fishery resources rather than to protection and preservation of a unique ecosystem.

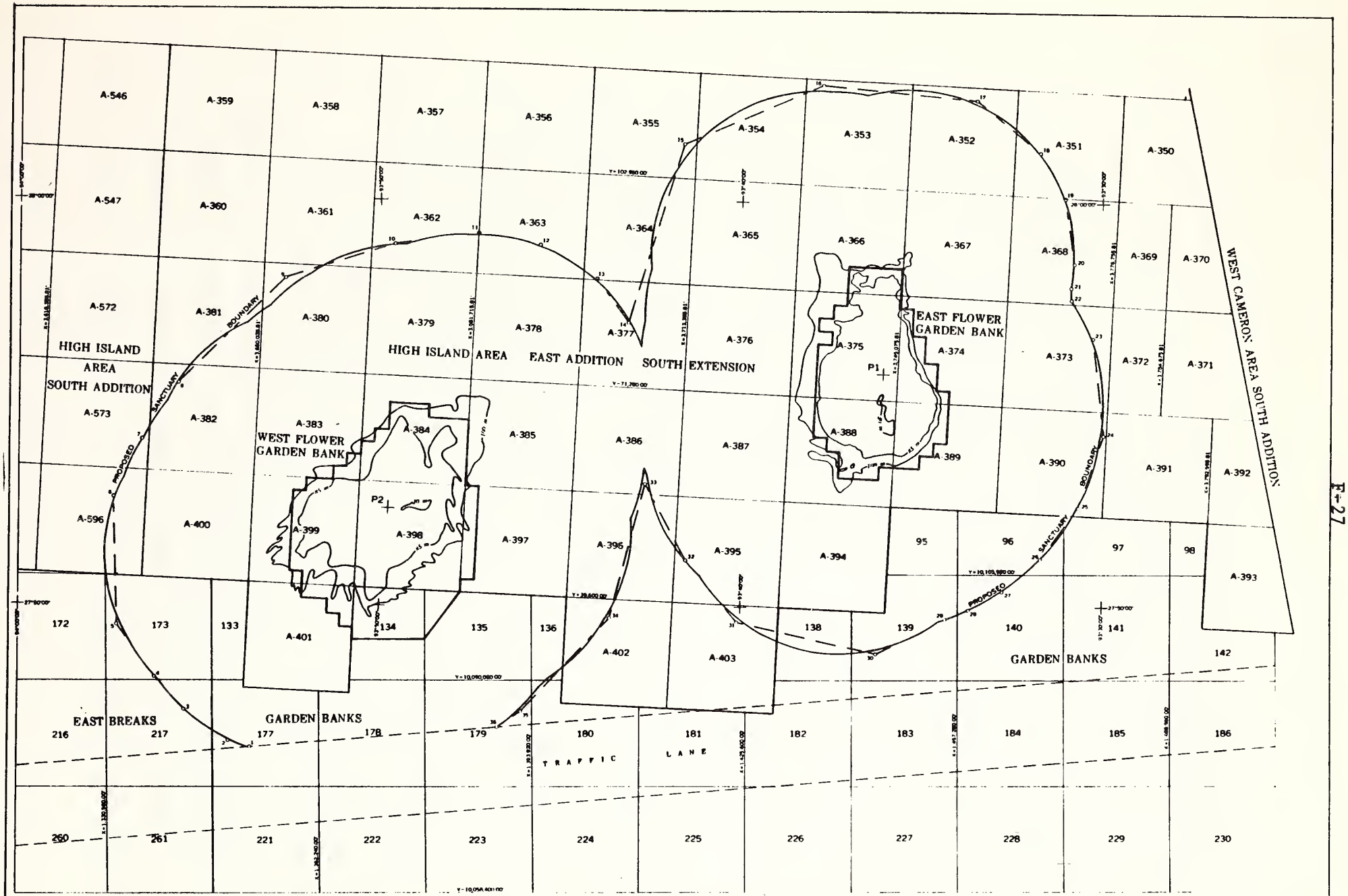
The increased unregulated harm from pollution and physical damage could irreversibly damage the Banks ecological, recreational and aesthetic values.

2. The Preferred Marine Sanctuary

The proposed action is the designation of a marine sanctuary and the regulation of certain activities within its boundaries. The terms of the proposed designation document (Designation) and proposed regulations are set out in full after the Summary, above.

The proposed sanctuary consists of the waters overlaying and surrounding the East and West Flower Garden Banks. The proposed sanctuary is located in the Gulf of Mexico approximately 110 nm southeast of Galveston, Texas and 120 nm south of Cameron, Louisiana. The sanctuary would extend to a distance of 4 nm from the 100 m isobath of each bank, and consists of 173.25 square nautical miles. See Figure F-7.

The regulatory system for a marine sanctuary will be established by two documents, the Designation and the regulations issued pursuant to Section 302(f) of the Act. The Designation will serve as a constitution for the sanctuary, establishing among other things the purposes of the sanctuary, the types of activities that may be subject to regulation within it and the extent to which other regulatory programs will continue to be effective. The Designation requires the approval of the President. Its content can be altered only after going through the whole designation process again and securing Presidential approval of a new or amended Designation. In order to protect the values of the Flower Garden Banks, under the terms of the proposed Designation, the following activities, and only the following activities, may be subject to marine sanctuary regulation:



EAST AND WEST FLOWER GARDEN BANK AREAS

PROTECTIVE RESTRICTIONS BOUNDARIES

SCALE 1 : 1000

Figure F-7. Proposed boundary for the Flower Garden Banks Marine Sanctuary.

- Removing, breaking or otherwise deliberately harming coral, bottom formations or marine invertebrates or plants, or taking tropical fish, except incidentally to other fishing operations.
- Operations of vessels other than fishing vessels, including anchoring and navigation, and anchoring by fishing vessels.
- Dredging, or altering the seabed in any manner.
- Construction.
- Discharging or depositing any substance or object.
- Using poisons, electric charges, spearguns or explosives.
- Trawling or dragging bottom gear within the 100 m (328 ft.) isobaths.

The regulations proposed in the preferred marine sanctuary control aspects of the activities listed in the Designation to the extent necessary to protect the ecosystem and other resources of the Banks. For certain activities listed in the Designation no current regulation is proposed. In these instances, while some current or potential threat is posed to the Bank resources, OCZM has concluded that regulations should not now be proposed, either because certain important data are unavailable or because cooperation and coordination with other agencies or other non-regulatory alternatives should be first pursued. Specifically, spearfishing and navigation by vessels in the sanctuary, while listed in the Designation, are not now the subject of proposed regulations.

The Designation generally exempts fishing operations from marine sanctuary regulation (Article 5, Section 1).

Generally speaking, permits, licenses and other authorities to act within the proposed sanctuary would remain valid under the preferred alternative unless the permit or license authorized an action which would violate a marine sanctuary regulation. The proposed regulation would certify the validity of such permits and licenses in advance to avoid unnecessary and costly delays for users of the resource.

In specific and limited situations, a permit may be granted by the Assistant Administrator for Coastal Zone Management authorizing activity within the sanctuary even though the activity violates sanctuary regulations. The preferred alternative will affect the reefs and the associated human environment primarily through the impact of the proposed regulations.

a. Oil and Gas Operations

The regulations proposed protect the hard bank reefal ecosystem from direct physical damage from oil and gas operations and regulate discharges from existing oil and gas leases to avoid harm from pollution. A moritorium on oil and gas operations on leases issued after the effective date of the regulations establishes a period during which intensive evaluation may fully consider the remaining questions concerning the impacts of oil and gas operations on the Banks in order to assure the continued health of the ecosystem. The significant impacts of the major regulations comprising the preferred marine sanctuary alternative are discussed below. Table F-2 is a comparison of the NOAA/EPA proposal, which includes NOAA's preferred alternative for oil and gas regulations, with BLM's present lease stipulation.

Table F-2 Comparison of NOAA/EPA Proposal for Oil and Gas Operating

Criteria and BLM Revised Stipulation

REQUIREMENT	BLM	NOAA/EPA
Sanctuary boundary	BLM proposed: within 85 m isobath as defined by quarter-quarter-quarter designation.	4 nm from the 100 m isobath.
No activity zone boundary.	BLM actual: within 85 m isobath as defined by quarter-quarter-quarter designation.	For existing leases 85-meter isobath as defined by quarter-quarter-quarter designation or actual 100-m isobath, whichever is farther from Bank mid-point. Note: operations on leases issued after sanctuary designation within 4-nm of the 100-m isobath will be prohibited for 5 yrs. from date of sanctuary designation.
Shunting	Required within approximately 3-nm from 85 m isobath; to within 10-m of bottom.	Required for allowed discharges within a zone 4 nm from 100-m isobath to within 6-m from bottom
Monitoring	Required within a zone approximately 1-m from 85-m isobath.	Required on all shunting operations within sanctuary.
Monitoring Requirements	Once before, periodically during and once after.	Once before, frequently during and once after drilling with parameters, timing and other requirements as specified in NPDES permits.
Bulk dischage of muds	Occasional prohibition in vicinity of biologically significant areas.	Prohibited in sanctuary.

Table F-2 Continued

Deck drainage and discharges of cooling waters and sanitary wastes	-	In compliance with NPDES permit.
Discharge from only one well at a time	-	Required with waiver provision in NPDES permits.
Use of toxic bactericides	Prohibited in biologically significant areas.	Subject to toxic substance provisions of NPDES permit.
Contingency plans	For oil spills - not required by BLM but required by USGS. Barging required if determined by USGS Supervisor.	For oil spills and to establish procedure to be followed if a no-discharge condition is imposed under NPDES permit.
Moratorium	-	Moratorium for five years on all oil and gas exploration and exploitation activities on any leased area within the sanctuary which is leased after the effective date of sanctuary regulations.

§934.7. Hydrocarbon Operations

(a) Within the 85 m isobaths, as defined by the quarter-quarter-quarter system in Appendix A, or within the 100 m (328 ft) isobaths where such areas extend further from the midpoint of either bank (27°55''07.44"N; 93°36'08.49"W for the East Bank and 27° 52'14.21"N; 93°48'54.79"W for the West Bank) exploration for or exploitation of hydrocarbons is prohibited.

(b) Outside the area defined by paragraph (a), hydrocarbon exploration and exploitation pursuant to any lease executed prior to the effective date of these regulations is allowed subject to all prohibitions, restrictions and conditions imposed by applicable regulations, permits, licenses or other authorizations including those issued by the Department of the Interior, the Coast Guard, the Corps of Engineers and the Environmental Protection Agency, and subject further to the following:

(i) Cuttings and adherent drillings muds must be shunted to within 6 m of the bottom.

(ii) Bulk discharges of drilling muds are prohibited.

(iii) The simultaneous discharge of the effluents from more than one well from a single rig or platform is prohibited.

(iv) The effects of drill cuttings and effluents upon Sanctuary resources shall be monitored at least once before drilling, frequently during drilling, and at least once after drilling in accordance with the specific requirements set forth in the permits issued by the Environmental Protection Agency pursuant to Section 402 of the Federal Water Pollution Control Act, 33 U.S.C. 1431 in agreement with NOAA.

(c) Hydrocarbon exploration and exploitation activities pursuant to leases excuted on or after the effective date of these regulations are prohibited anywhere in the Sanctuary for a period of five years from such effective date.

No activity zone

All hydrocarbon operations are prohibited within the particularly important hard bank areas to protect the various components of the reef ecosystem. This no activity zone includes primarily the area where such activi-

ties are already prohibited by BLM (within the 85 m isobaths as defined by the quarter-quarter-quarter system) but extends to the 100 m isobaths where they are further from the Banks midpoints. Figures F-8 and F-9. In this area, drilling operations would destroy or injure coral either directly or by pollution.

The no activity zone as proposed provides a significant degree of protection for the corals and associated marine organisms, including crinoids. Since no drilling, mooring, discharging, or other activity is allowed within this zone, these biological communities will be fully protected from the direct effects of physical alteration. The no activity zone boundary may not, however, protect the reefs and associated organisms from pollution that might occur outside the no activity zone, or even outside the sanctuary.

The extension of the no activity zone in the small areas where the 100 m isobath extends beyond the BLM stipulation area is essential to avoid discharges directly into the crinoid zone on the Banks. These major filter feeders have an important ecological role and would be severely impacted by direct discharge into their habitat. The expanded no activity zone attempts to protect more adequately an important element of the reefal ecosystem.

The proposed no activity zone is expected to have little if any additional economic impact beyond that of present BLM lease stipulations. In those cases where the 100 m isobath extends further from the Banks' midpoints than the BLM-defined 85 m boundary, slightly broader protection is provided by the 100 m isobath boundary. The proposed extension of

the no activity zone to the 100 m isobath in the small areas depicted in Figures F-8 and F-9 will not significantly affect existing leases held by Mobil, Union of California and American Natural Gas Production Company. Resources from these leased tracts will be retrievable via drilling operations located outside the slightly enlarged no activity zone. There are not expected to be significant increases in operating costs because of this regulation.

§934.6(a)(3). Altering of or construction on the seabed.

> No person shall dredge, drill, or otherwise alter the seabed in any way, nor construct any structure except for navigation aids, within the area of the Sanctuary defined by the 100 m (328 ft.) isobaths.

This separate and specific regulation would prohibit any construction or alteration of the seabed within the 100 m isobath, the no activity zone. Placement of platforms or other OCS related construction such as pipelines would either injure the reefs or destroy habitat of related organisms. Since BLM stipulations now prohibit such construction, except in the small additional areas identified above, and since oil and gas related construction is the only construction likely at the Banks, the impact of the prohibition would be minimal.

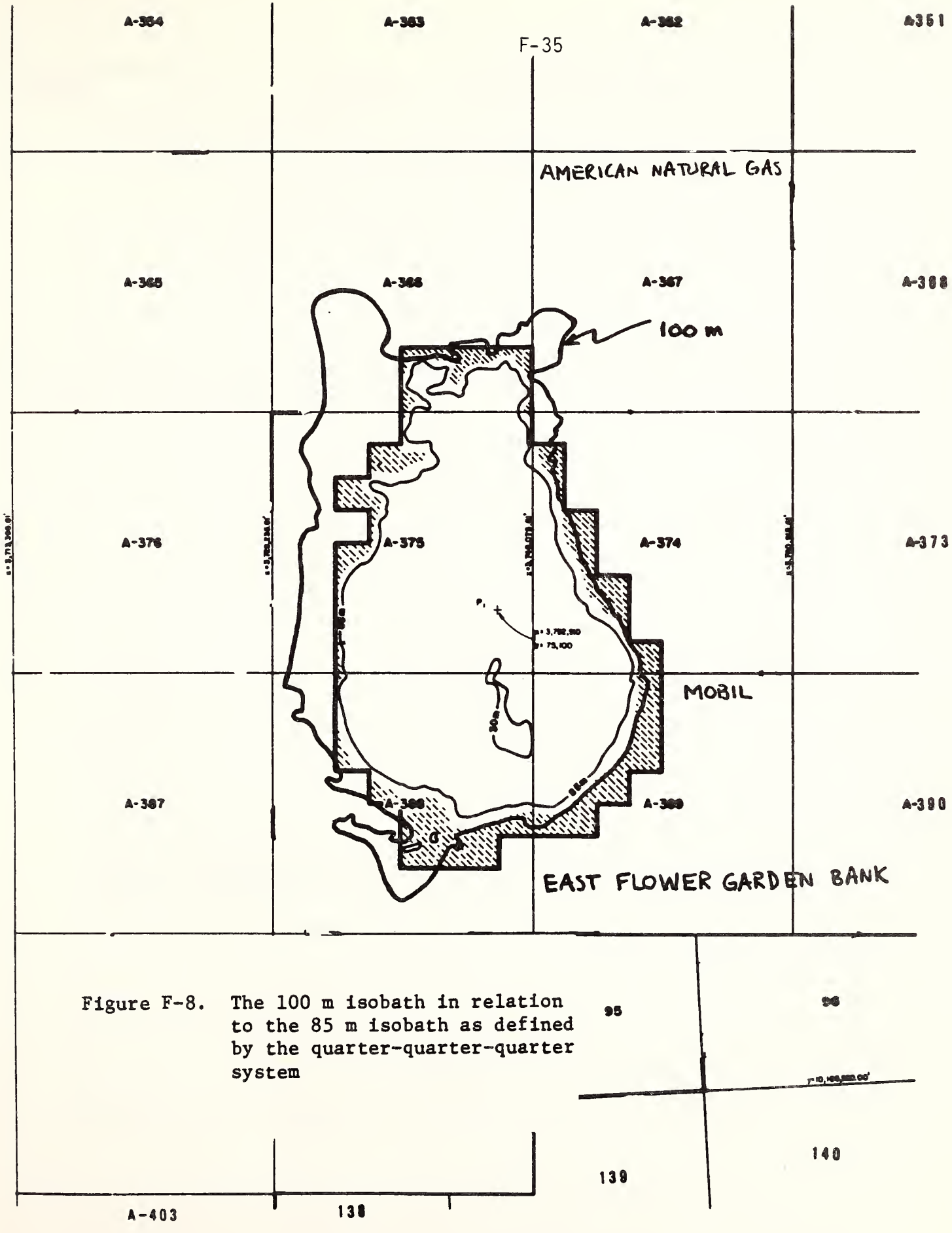


Figure F-8. The 100 m isobath in relation to the 85 m isobath as defined by the quarter-quarter-quarter system

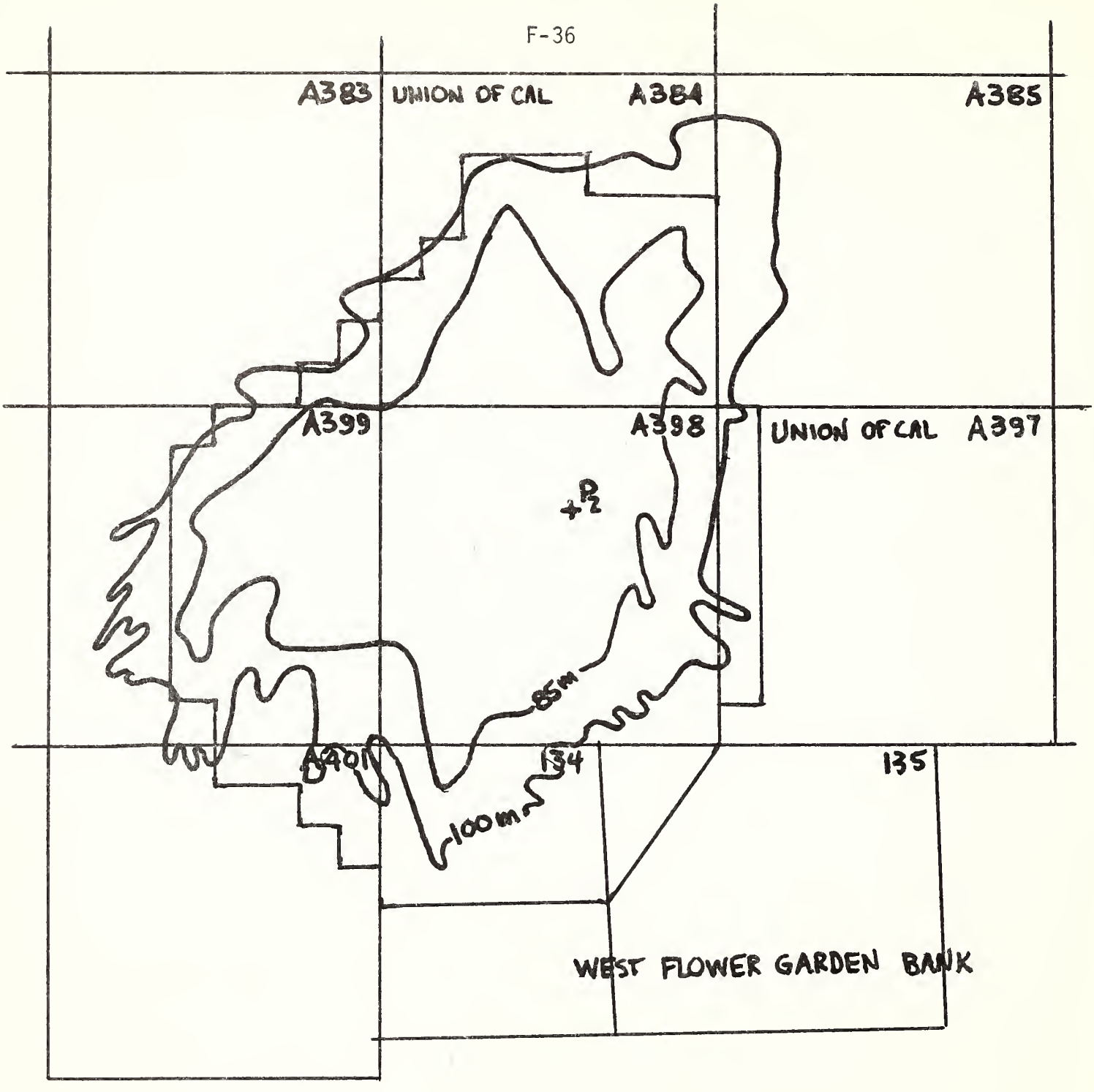


Figure F-9. The 100 m isobath in relation to the 85 m isobath as defined by the quarter-quarter-quarter system

Regulation of operations

In the sanctuary outside the no activity zone, hydrocarbon operations under existing leases may continue subject to conditions imposed by other authorities and those additional conditions designed to minimize pollution listed in section 934.7(b) of the marine sanctuary regulations. The Environmental Protection Agency (EPA) and NOAA have agreed that these proposed regulations and the conditions of EPA's permits issued under Section 402 of the Federal Water Pollution Control Act, 33 U.S.C. 1431, (known as NPDES permits) will correspond to the maximum extent practicable.

Shunting to within 6 m of bottom

All discharges of drill cuttings and adherent muds must be shunted to within 6 m of the sea bottom in the sanctuary. This technique eliminates plumes from the biologically richer surface waters where sensitive planktonic larval forms typically abound, and significantly reduces the likelihood of drilling effluents attaining high concentrations over Bank and reef areas. Shunting also reduces the distance sediment particles must fall to reach the bottom and, thus, theoretically limits the horizontal extent of effluent transport. Shunting to 6 m offers greater probability that the material will actually be deposited in the nepheloid layer than does the present BLM requirement of shunting to 10 m. The nepheloid layer ranges to thickness from 1 to 20 meters and deeper shunting minimizes the chances that sediments will spread through the water column. The

regulation reduces the likelihood that water-clouding sediments will reduce light levels upon which corals are dependent, and reduces contact with polluting materials.

There remains the possibility that injecting these materials into the nepheloid layer may contribute to their transport over broad areas at depth. Also, shunting into the nepheloid layer does not prevent the materials from being transported biologically. As the materials are ingested by benthic filter and deposit feeders, such materials may be translocated to larvae or to predators and vertically migrating organisms. Thus, substantial volumes of toxic bioaccumulable substances may still enter the food web. At the present time not enough information is available to enable a determination of the impacts of injecting wastes into the nepheloid layer, however, shunting to within six meters of the bottom appears to be the preferable solution to the waste disposal problem. Bureau of Land Management reef monitoring studies have not indicated any effects on the reefs from shunting activities that have occured to date.

The economic impacts of this regulation are minor in relation to the costs of developing OCS resources. Bureau of Land Management stipulations already require shunting to within 10 m of the bottom on most existing leases within 3 nautical miles of the 85 m isobath. The sanctuary regulation imposes additional costs in two areas. First, adding an additional 4-meters of pipe to a shunting operation involves costs. The average cost of fabricating

and installing an entire shunt pipe is $32,000 according to the Offshore Operators Committee. An additional four meters of pipe would add a negligible additional amount to the cost of fabrication and installation.

The second additional cost arises because the sanctuary is larger than the BLM stipulation area where shunting is required. This additional area of shunting varies from 1 to 2 miles in width, the difference between the BLM pre-December 1, 1978, stipulation and the sanctuary boundary, 4 nm from the 100 m isobath. See Figure F-10. On two leases -- Union on Block A-397 and Union on Block A-378 -- the new post-December 1, 1978, stipulation applies. The new stipulation will require Mobil to shunt on the entire Block A-397 and on the southwest half of Block A-378.

In all, 23 leased tracts will have major and minor segments subject to the shunting regulation. Nine tracts, lying mostly outside the sanctuary boundary, will be only slightly affected. Three tracts fall within the shunting requirement implemented by BLM, and will, thus, not be subject to significant additional shunting costs as a result of the marine sanctuary regulations. These tracts are Union's Block A-384 and Mobil's Block A-389, Under the pre-December 1, 1978, stipulation and Union's Block A-397 under the post-December 1, 1978, stipulation. Eleven leased tracts would be significantly affected by the expanded shunting area, five at the West Flower Garden Bank -- Mobil's A-382, Mobil's A-379, Union's A-378, Phillip's A-377, and Sun's A-396 -- and six at the East Flower Garden Bank -- Sun's A-365, Texaco's A-376, Union's A-395, ANG's A-367, Exxon's A-362, and Hunt's A-368. USGS estimates that the cost to shunt ranges from $50,000 to $82,000 per platform. The cost of shunting for individual wells could be as much as $32,000 per well, as discussed above.

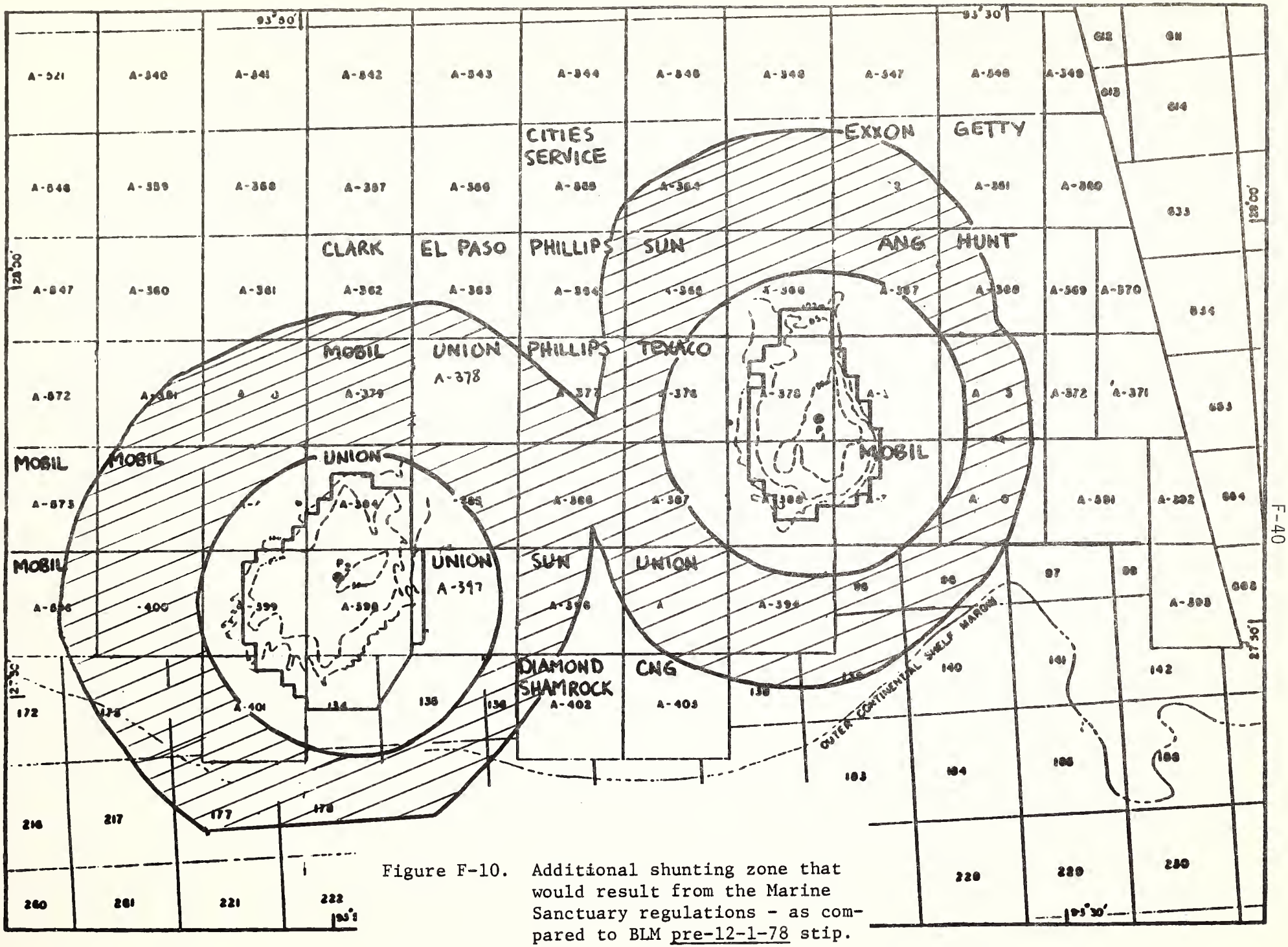


Figure F-10. Additional shunting zone that would result from the Marine Sanctuary regulations - as compared to BLM pre-12-1-78 stip.

When additional costs are imposed, there is always the risk that a marginal resource may become uneconomic to produce. While it is unlikely that the additional costs of shunting would be sufficient to convert a minimally economic resource into an uneconomic resource, the possibility must be recognized in an evaluation of the economic impacts. Based simply on the overall costs of operating in the Gulf, particularly in the Flower Garden Banks area where depths exceed 400 feet and costs of platform fabrication alone approach 20 million dollars, it is unlikely that the additional $50,000 to $80,000 per platform cost of shunting would be significant relative to total cost. Thus, OCZM does not expect that the expanded shunting zone will produce any irreversible or irretrievable loss of resources.

Prohibition of bulk discharges

The bulk discharges of drilling muds that typically occur once or twice during the drilling of each well are prohibited. Bulk discharge under the proposed regulations means "a discharge of drill fluids and cuttings other than that of materials separated out by properly operating shale shaker, desander and desilter units; i.e. drill fluids and cuttings contained on the drill facility at the termination of drilling each well hole and drill fluids and cuttings evacuated from the drill fluid system during the course of drilling, for the purpose of reconstituting the operational drill fluid." §934.4(c)

The environmental impact of the no-bulk discharge regulation will be reduced potential for harm to the reefs from a large and rapid deposit of waste muds into the nepheloid layer. Since monitoring is not presently required at the moment of bulk discharges, the precise benefits in terms of harm prevented cannot be quantified. However, the potential dangers from depositing operational discharges of drilling effluents through a shunt pipe are magnified by a bulk discharge.

Bulk waste mud would be transported either to another drilling operation for reuse or for disposal onshore or to a dump site approved by EPA. Attempts to estimate the economic effects on a no-bulk discharge requirement have not been too successful. BLM's stipulations for blocks A-397 and A-391, leases held by American Natural Gas Production Company (ANG) and Sunmark, respectively, impose a no-bulk discharge requirement. Unfortunately neither ANG (Cogrevich, 1978, personal communication) nor Sunmark (Johnson 1978, personal communication) has separated out the costs of meeting this requirement. The Offshore Operators Committee also does not have these costs available (Berry, 1978, personal communication). Mobil estimates the cost of prohibiting bulk discharges to be an additional $20,000 per well (C. R. Kreuz, 1978, personal communication, Mobil Oil Corporation, 1978).

The costs are primarily those involved in transport of the muds by barge or mud boat. Barges are basically floating storage boxes which must

rely on separate tugs or vessels for propulsion while mud boats are self propelled vessels containing specially designed heavy walled mud storage tanks. The limitations for barges are especially significant at such distances from shore (203 km or 110 m). They are not self-propelled and must instead be pulled by means of a cable attached to a tug. Poor maneuverability and the risk of a cable snapping during periods of bad weather or heavy seas make the routine use of barges an unsafe practice--particularly if the barge were to capsize and release large quantities of effluent into the surface waters over or near the coral reefs. This safety risk is greatly reduced by self-propelled mud boats.

Mud boat transport of bulk muds will increase vessel traffic near the Banks to some degree. Unless drilling is stopped during periods of bad weather and high seas, it is also possible that a barge or loading equipment (pipes) may be knocked over and its cargo dumped directly into the water adjacent to platforms. If the effluent is to be transported to an open water discharge site, an ocean dumping permit from EPA would be necessary. Although some safety risks are involved, the fact that the industry moves muds to drilling sites safely and, when economically worthwhile, transports reuseable muds to another drill site, diminishes the degree of concern. Also, since the transport is not required on a continual basis, it seems likely that decisions to move the muds could be timed to coincide with good weather, further reducing the problems involved.

Prohibition of simultanous discharge of effluent from more than one well from a single rig or platform

This prohibition will limit the quantity and concentration of effluents being discharged into a particular water area. The restriction seeks to assure that dispersal and dilution of pollutants is not compromised by simultaneous discharges. In those cases where it may be desirable to allow simultaneous discharge, the NPDES permit conditions may provide for a waiver of the restriction.

The economic impact of the regulation will be minimal since it is normal industry practice to drill and discharge from only one well at a time on a single rig or platform (OOC, 1978).

Monitoring of discharges

All discharges of drill cuttings and effluents within the sanctuary must be monitored for the effects of these effluents on the reef ecosystem. The monitoring will include certain studies before drilling, monitoring frequently during the drilling, and at least one study after the drilling of each well with parameters, timing and other requirements as specified in the NPDES permit. The monitoring parameters not specified in this regulation will be agreed upon by NOAA and EPA and will be contained as conditions in the NPDES permit which must be obtained prior to any discharge in the sanctuary. There will be one set of monitoring requirements for both regulatory agencies. This unified approach may enable

the agencies to work closely with industry to identify the studies that need to be undertaken to understand the reef resources and the degree of protection the resources require. Most importantly, the monitoring requirement will provide data upon which discussions about required regulation can be based. The data may demonstrate greater or lesser strictures are required to preserve a healthy reef ecosystem. There remain substantial scientific doubts concerning the safety of shunted effluent disposal. The monitoring data will enable a more informed decision on this issue.

The economic impact of the monitoring program will be the additional direct costs to the operators and the cost to society should the required monitoring program render an otherwise marginally economic resource uneconomic to produce. While average costs of monitoring per well are difficult to estimate due to differences in length of drilling time, weather, specific monitoring requirements, and other factors, approximate costs from previous studies can be provided. The cost of the monitoring studies on two exploratory wells drilled by Mobil Oil Corporation was $140,000 (exclusive of boat, fuel and food costs) (Getterson, 1978, personal communication). The second study in tract A-389, on two other wells, cost $210,000. Another example of the cost of monitoring studies is provided by the operations of American Nautral Gas Production Company in block A-367 northeast of the East Flower Garden Bank. ANG drilled one explora-

tory well which was monitored by Continental Shelf Associates in three stages: before drilling, 15 days after starting to drill and on the completion of drilling. The cost of the monitoring effort is expected to run from $50,000 to $75,000. The main reason that the Mobil effort and the American Natural Gas effort differ in cost is that drilling time for Mobil lasted 3 months, for American Nautral Gas 40 days.

An additional economic burden beyond the present costs imposed by BLM will fall on operators who discharge between the monitoring zone required by BLM and the proposed marine sanctuary boundary. For leases issued under the pre-December 1, 1978, stipulation, the zone of additional monitoring is depicted in Figure F-11. A maximum of 20 tracts could be affected -- 8 on outlying segments of the sanctuary probably would not incur any additional restriction; but 10 would have major portions of the lease come under the monitoring requirement while 2, namely Union A-384 and Mobil A-389, are already under the BLM monitoring requirement. For leases issued under the new stipulation, the marine sanctuary monitoring requirement will affect two tracts -- Union's A-378 and A-397 -- by imposing an additional monitoring zone. (See Figure F-11a).

For the leases located partially outside the sanctuary, depending upon where the resource is found, the monitoring requirement may be avoidable by operating outside the sanctuary. It is impossible at this point, however, in the absence of data on where the resources are located, to estimate the additional costs that would be incurred on individual leases except to reiterate that the approximate costs of monitoring is $300-500 thousand per well.

No marine sanctuary regulations concerning spill contingency plans, no-discharge contingency plans, miscellaneous discharges, and prohibited or toxic substances are proposed. The requirements in these areas will be established in

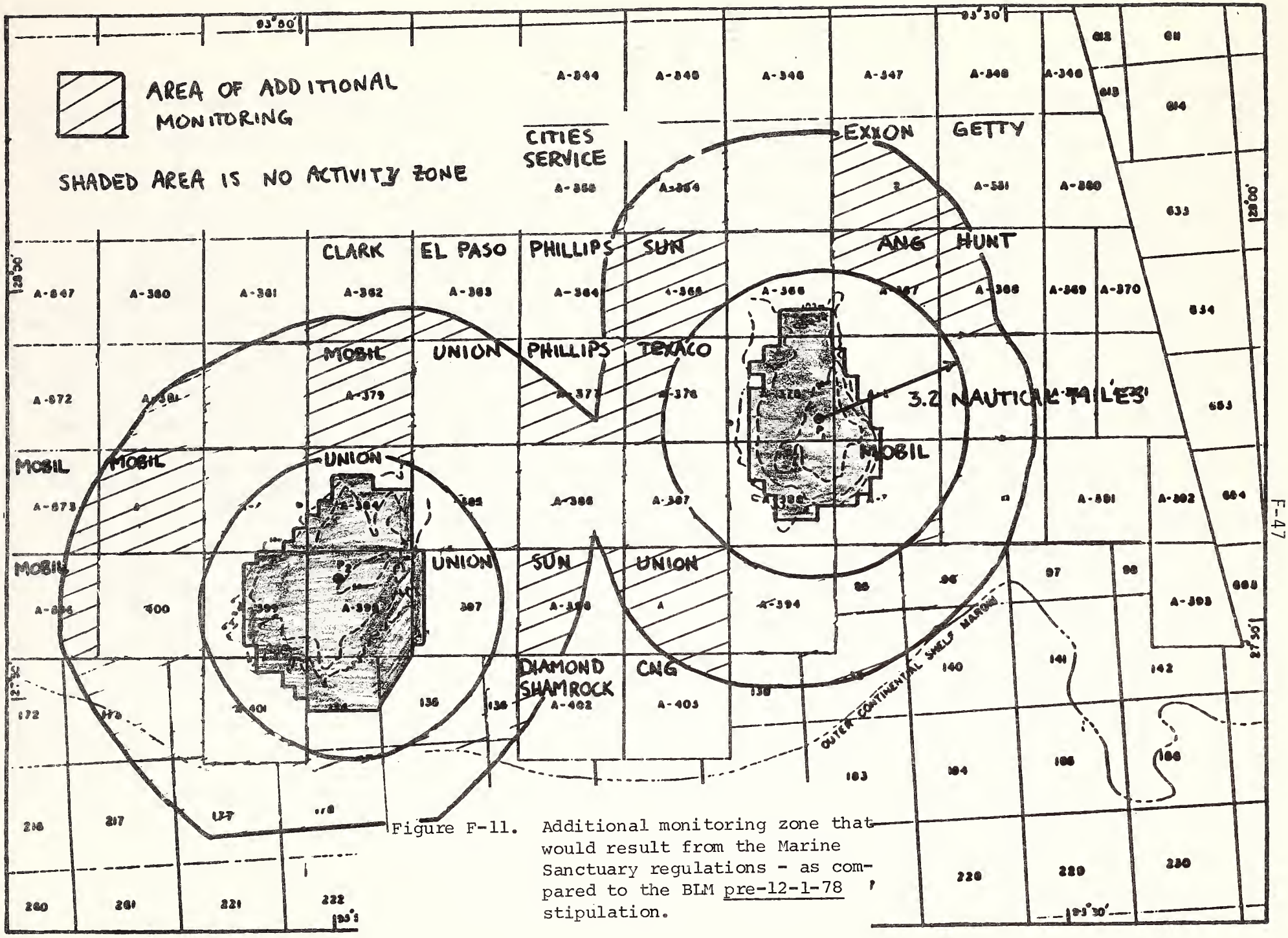


Figure F-11. Additional monitoring zone that would result from the Marine Sanctuary regulations - as compared to the BLM pre-12-1-78 stipulation.

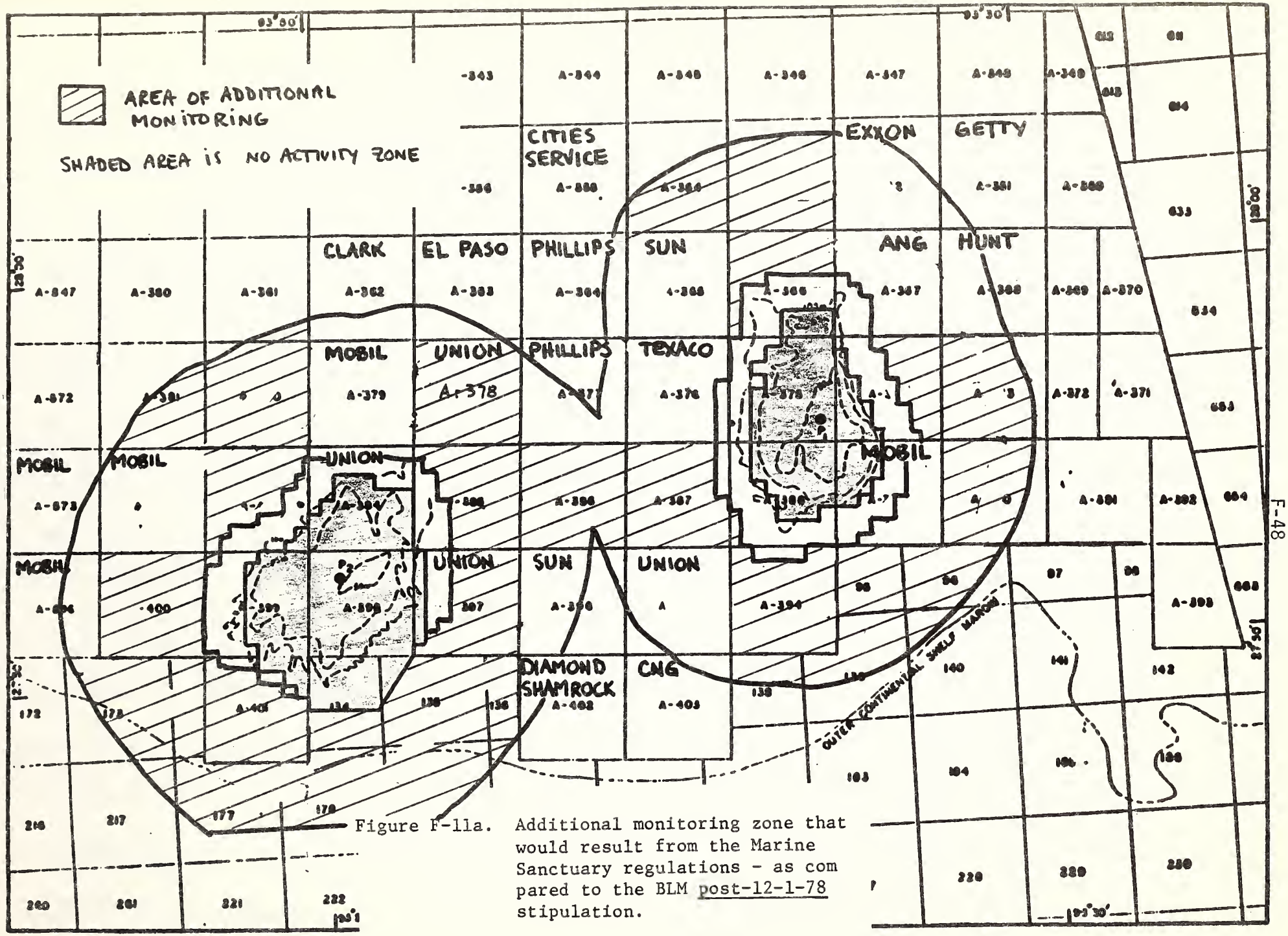


Figure F-11a. Additional monitoring zone that would result from the Marine Sanctuary regulations - as compared to the BLM post-12-1-78 stipulation.

EPS's NPDES permits. Consultation and coordination with EPA will be assured. See EPA/NOAA Principles of Agreement, Appendix 3.

Moratorium on oil and gas operations on future leases

No hydrocarbon exploration and exploitation under leases issued after the effective date of the sanctuary regulations will be allowed within the Sanctuary for a period of five years to provide an adequate period for the monitoring program described above to evaluate the effects of oil and gas operations on the bank. The greater understanding of the impacts of oil and gas development gained during the moratorium will be used to reevaluate the scope of appropriate regulations of petroleum exploration and extraction in the sanctuary.

This moratorium on oil and gas operations will not affect tracts leased before the effective date of the regulations. Twenty-three tracts have already been leased within the sanctuary and will not be affected by the moratorium. At present there are 18 unleased tracts that fall entirely within the proposed sanctuary boundary. The moratorium would prohibit oil and gas exploration and exploitation operations on any of these tracts leased on or after the effective date of the sanctuary regulations for five years from that date. It is unlikely that the industry will bid on tracts which it will not be allowed to develop for five years and for which the restrictions on petroleum development after that time are uncertain. Thus, the moratorium will discourage bidding on such tracts. There are 16 unleased tracts that fall partially within the proposed sanctuary boundaries. It may be possible to extract resources on these tracts during the

moratorium by means of directional drilling from outside the sanctuary boundary. Petroleum companies may decide to bid on such tracts despite the provisions of the moratorium, if they determine that the resource can be economically recovered, but the moratorium seems likely to discourage bidding on these tracts as well.

The moratorium would provide the means for significantly improving the protection of the reefs should that prove necessary. It would limit the amount of petroleum exploration and extraction taking place in the sanctuary and consequently limit or postpone all adverse effects that may result from activities associated with hydrocarbon development. The existing information on the chronic and acute effects of drilling muds and cuttings on corals and other reef biota is very limited, as is information on the transport of shunted material at the Flower Garden Banks. A five year moratorium on exploration and exploitation of newly leased tracts would provide time for the sanctuary managers to gather and analyze data on the effects of petroleum development activities and to determine the best practicable restrictions to be imposed on oil and gas activities after the moratorium expires. The proposed regulations require monitoring of discharges before, during, and after drilling and delivery of the results of all research conducted in the sanctuary to the sanctuary managers. These provisions ensure that information will be gathered that will help determine the level of regulation needed to protect the resources of the Banks. In addition, a joint research effort by EPA and NOAA will focus

on questions that remain concerning the impact of oil and gas operations on the Banks.

Economic Impacts

The economic impact of the proposed moratorium will probably not be significant although it could possibly have some minor adverse impacts on the petroleum industry and the Federal government. The moratorium has no impact on leases which predate the effective date of the proposed sanctuary regulations. The proposed regulation will likely prevent developers from bidding on the affected leases for the duration of the moratorium. These decisions by the oil and gas industry will have no economic impact as long as there are sufficient substitute tracts available in the Gulf of Mexico region which offer an investment opportunity as productive as that of the Flower Garden Banks.

The Department of the Interior draft lease schedule indicates that some 6 million acres, or 1500 tracts may be offered for lease over the next five years in the Gulf of Mexico. Because of the protracted period of time between leasing and production and the current and expected availability of substitute unleased OCS tracts in the area, the economic effect of discouraging bidding on some 34 tracts, with no proven reserve estimates, from oil and gas production for five years will be small. With a surplus of tracts available for exploration and possible production, the preclusion of a small number of unleased tracts within the proposed Flower Garden Banks Marine Sanctuary should at most cause industry minimal opportunity costs. Likewise, since the Federal government has a surplus

of potential tracts available for leasing over the 5-year period, it will not lose any bonus revenues nor any interest income which may accrue so long as it substitutes some of the surplus acreage for tracts withheld due to the moratorium.

b. Recreation

The regulations proposed protect the corals, other creatures, and reef formations from the impacts of souvenir and specimen collection, physical damage from anchoring by recreational vessels, harm from discharge from such vessels and from any other littering or disposal of refuse. Minimal safety requirements to protect users of the reef are also proposed.

Souvenir and specimen collection

§934.6(a) Removing or damaging distinctive natural features - generally.

(A) No person shall break, cut or similarly damage or destroy any coral or bottom formation, any marine invertebrate or any marine plant. Divers are prohibited from handling coral or standing on coral formations.

(B) No person shall collect or remove any coral or bottom formation, or marine plant. No person shall take, except incidentally to other fishing operations, any marine invertebrate (except for dead shells) nor any tropical fish which is a fish of minimal sport and food value, usually brightly colored, often used for aquaria purposes and which lives in a direct interrelationship with the corals. There shall be a rebuttable presumption that any items listed in this paragraph found in the possession of a person within the Sanctuary have been collected or removed from within the Sanctuary.

(C) No person shall use poisons, electric charges, explosives or similar methods to take any marine animal or plant.

These regulations provide a high degree of environmental protection to corals and other reef organisms and preserve the ecosystem intact. Because the growth of corals is in centimeters per year, collection of specimens can have lasting negative effects. This is particularly true because damage can extend beyond simply the specimens collected. If the living reef is injured, the damaged area can become infected by algae and harm spreads beyond that expected from limited removal of a souvenir.

The regulations are designed to protect the ecosystem's 18 species of coral, more than 100 species of Caribbean reef fishes and 200 species of invertebrates that have been identified at the Banks. This complex community should be preserved in as close to its natural state as possible in order to preserve its research, recreational and aesthetic values. Collection is a particular problem in a system where certain species are rare and recruitment sources so distant as to render reinstatement of a species very unlikely. The present extraordinary diversity of the Banks must be preserved.

The regulation will not significantly diminish the level of recreational activity nor alter recreational use patterns. In some instances where divers collect mementos, the enjoyment of the diving experience may be decreased slightly. This is offset, however, by insuring that future divers at the reefs will be able to enjoy the full complement of reef resources. The

individual collector's benefit does not extend to the public at large and in no event can it outweigh the potential cumulative environmental impacts of reduced species abundance and diversity, impaired research potential, and degraded aesthetic appeal.

The regulations do not prohibit taking of marine animals or plants incidentally to allowed fishing operations, including hook and line and spearfishing.

Recreational boating

§934.6(a)(2) Injurious Vessel Operations.

(A) No vessel except a recreational vessel shall anchor within the area of the Sanctuary defined by the 100 m (328 ft.) isobaths.

(B) No person shall place any rope, chain, or anchor in such a way as to injure any coral or other bottom formation anywhere within the Sanctuary. All practicable efforts shall be taken to drop anchors on sand flats off the reefs and place them so as not to drift into the coral formations. When anchoring dive boats, the first diver down shall inspect the anchor to ensure that it is placed off the corals and will not shift in such a way as to damage corals. No further diving is permitted until the anchor is placed in accordance with these requirements.

(C) All vessels from which diving operations are being conducted shall fly in a conspicuous manner the international code flag alpha "A." and no vessel under power shall approach closer than 300 ft. (92 m) of a boat displaying the diving flag except at a maximum speed of 3 knots.

The proposed regulation combines the benefits of reducing future anchor damage by recreational boats while allowing continued recreational activity. In this instance, the tremendous recreational and public educa-

tion value of this regionally unique resource is considered more important than the possible anchor damage that may continue to result from recreational use. The regulation requires anchoring practices which will minimize the damages from direct impacts of anchors and from chafing by anchor lines. There are no economic impacts from the proposed regulation.

However, careful anchoring practices may not preclude all future damage to the reefs. The sand flats at the reefs are small and thus difficult targets for lowered anchors to hit (Blood, 1978, personal communication). Even if anchors are successfully lowered onto sand flats, it is possible they could be dragged over to corals before grabbing hold. Once near coral heads, the anchor chain could chafe the corals and inflict damage. Although the required anchoring procedures would probably reduce damage, a certain amount of damage may continue. The overall results of the required anchoring practices depend on the effectiveness of a public information campaign urging adoption of the above measures. Future coral damage from anchoring could be reduced even with an increase in recreational visits. This management approach would not alter or restrict recreational use patterns at the reefs.

Requiring recreational boaters to anchor completely off the reefal zone would offer more protection but would eliminate most recreational use of the reef. The water is too deep for most anchoring and the distance from the reef would preclude safe diving. Further, if the required

anchoring procedures prove inadequate, another management approach, such as the placing of mooring buoys at the reefs, could be implemented. While the mooring buoys might substantially reduce anchor damage, the concentration of use would pose other problems discussed in detail below. The preferred alternative provides a reasonable compromise for protecting the resource and maintaining its availability for public use and enjoyment. The proposed regulations requiring display of a diving flag and limiting speed when approaching dive boats provide a measure of protection to ensure the safety of recreational users of the Banks. These regulations reflect accepted procedures by divers.

Discharges, littering and the disposal of refuse

§934.6(a)(5) Discharging polluting substances.

No person shall deposit or discharge any materials or substances of any kind except:

(A) indigenous fish or parts,

(B) effluents from marine sanitation devices,

(C) non-polluted cooling waters from ocean vessels, and

(D) effluents incidental to hydrocarbon exploration and exploitation activities as allowed by section 934.7.

No discharges or disposal of any wastes, with the limited exceptions specified above, are allowed within the sanctuary. The regulations should have minor implications for recreational vessels. The effects upon commercial vessels, particularly tankers, are discussed in relation to commercial shipping, below.

Since the disposal of solid wastes in the sanctuary is unnecessary and serves to reduce the aesthetic quality and recreational value of the Banks, the disposal of glass, cans, metal objects, plastic wrappers, and other solid wastes would be prohibited. The only exceptions to the prohibition would be for "chumming" associated with recreational fishing, disposal of fish remains, discharges from USCG approved marine sanitation devices and non-polluted cooling waters. The regulation would avoid potential harm to the reef ecosystem from chemical or other discharges and eliminate trash which diminishes the reef's recreational value. This option would have no significant socio-economic impact on reef users.

c. Commercial shipping

The proposed regulations protect the sanctuary's living resources from potential damage due to commercial shipping activities. The prohibition on discharge and disposal would avoid damage from deposit of oil and oily waste or other potentially harmful chemicals in the waters. The regulation also forbids disposal of trash. Further, a prohibition on anchoring by other than recreational vessels protects the area within the 100 m isobath on both banks. No restraints on vessel navigation are proposed, although following designation, OCZM would seek international recognition of the sanctuary as an "area to be avoided". The regulation of vessel operations in the sanctuary will be applied only in accordance with international law.

Discharge of wastes

§934.6(a)(5) Discharging polluting substances.

No person shall deposit or discharge any materials or substances of any kind except:

(A) indigenous fish or parts

(B) effluents from marine sanitation devices

(C) non-polluted cooling waters from ocean vessels

(D) effluents incidental to hydrocarbon exploration and exploitation activities as allowed by section 934.7.

(b) The prohibitions in this section are not based on any claim of territoriality and will be applied to foreign persons and vessels only in accordance with recognized principles of international law, including treaties, conventions and other international agreements to which the United States is signatory.

The regulations prohibit the discharge of almost all substances including oil and oily waste by vessels, including OCS supply ships, fishing boats and other vessels, within the sanctuary to the extent consistent with international law. This regulation would limit discharges threatening the resources of the Flower Garden Banks, to the extent the prohibition can be applied under international law. Since the boundary of the sanctuary extends to 4 nm from the 100 m isobath of the Banks, it would provide a buffer sufficient for dispersion and dilution of any discharges outside the sanctuary.

Since extrapolation from available data indicates that a substantial number of the ships transiting the area are of foreign registration, further internationally recognized measures will be employed to protect the resources of the sanctuary. International recognition of the Flower Garden Banks as an "area to be avoided" would reduce vessel traffic and simultaneously reduce the risk of harmful discharges from vessels. Recognition will be sought after designation from the International Maritime Consultative Organization. The procedure is described in more detail in the section on vessel navigation, below. Other internationally sanctioned measures such as mandatory vessel routing may be employed. The measures will be fully coordinated with the State Department and the USCG.

The costs imposed on commercial shipping by prohibiting discharges in this small area would be minimal. There is no economic or other need for any vessel to discharge waste while in the sanctuary boundaries. Thus, the differential impact on vessels which can be reached consistently with international law and any others which cannot be is also negligible. The sanctuary does not include any of the waters currently designated by the Corps of Engineers as the "Gulf Safety Fairway" which passes 11 km (6 nm) south of the Flower Garden Banks and the regulations would not affect conduct of vessel operations while in the Fairway.

Anchoring by commercial vessels

§934.6(a)(2). No vessel except a recreational vessel shall anchor within the area of the Sanctuary defined by the 100 m (328 ft.) isobath.

The regulation prohibits anchoring by commercial vessels, including OCS supply ships, within the 100 m isobath to the extent consistent with international law. The regulation affords protection to the live coral reefs, which occur above the 50 m isobath, from the direct effects of anchor damage. Additionally, the live coral area would be sheltered by a buffer zone from the effects of anchor chains, wires, or ropes, that might otherwise drag across the reefs. The buffer zone would assure that a vessel anchored just beyond the 100 m contour could not, even with a maximum extension of its line, impact the live reef.

The buffer zone between reef zone (50 m isobath) and the 100 m isobath extends at the West Flower Garden a horizontal distance varying from 300 to 1000 meters (1000 to 3000 ft.) (Bright and Pequegnat, 1974), and from 400 to 4430 meters (1,580 to 14,500 ft.) at the East Flower Garden (Bright, 1977). The 100 m anchoring prohibition will incidentally prevent disruption of the hard bank to 100 m, although anchor chains might still drag across some of the deeper portions of the hard banks and disturb the bottom.

The regulation will be applied to foreign vessels in accordance with recognized principles of international law. Article 2 of the 1958 Geneva Convention on the Continental Shelf established the sovereign rights of coastal nations to explore and exploit the natural resources of the continental shelf. Coral reefs, like the Flower Gardens, are such resources (United States v. Ray, 423 F.2d 16 (1979)). Such right to

protect such resources may be sufficiently broad to prevent actions such as anchoring, which will necessarily result in damage to the resource, although such protection cannot unjustifiably hamper navigation. The prohibition here is limited to the narrow area where harm to the reef is otherwise unavoidable, and where there is no apparent need to anchor on the reefs.

This minimal restriction on anchoring imposes no socioeconomic costs and, unlike the case of recreational vessels, commercial vessels have no reason to be at the Banks. Anchoring under emergency conditions would not be affected by the prohibition.

Vessel navigation

No restraints on vessel navigation are proposed in the preferred marine sanctuary. The preferred approach to problems generated by vessel navigation, particularly by deep draft vessels, is international recognition of the sanctuary as an area to be avoided. However, to preserve the ability to regulate deep draft vessel traffic, at least by domestic vessels, without amending the designation of the sanctuary, language granting authority to promulgate necessary regulations, in accordance with international law, has been included in the designation:

Article 4. Scope of Regulation

Section 1. Activities Subject to Regulation. In order to protect the distinctive values of the Flower Garden Banks, the following activities may be regulated within the Sanctuary to the extent necessary to ensure the protection and preservation of the coral and other marine features and the ecological, recreational, and esthetic value of the area:

* * *

b. Operations of vessels other than fishing vessels, including anchoring and navigation, and anchoring by fishing vessels.

Any regulation of vessel navigation which is determined necessary in the future would, be proposed under the notice and comment requirements of the Administrative Procedure Act, the restrictions of the National Environmental Policy Act, and all other requirements. The ability to regulate this particular activity without amending the Designation is significant because a combination of factors likely to occur over the next five to ten years will increase the number of vessels, particularly deep draft vessels, navigating the western Gulf of Mexico near the Flower Gardens. Although the probability of harm from the traffic, particularly by deep draft vessels grounding on the Banks, remains small, the impacts of grounding on the coral reef formations and the reef ecosystem could be major. The future protection of the Banks requires the ability to regulate such navigation if it proves necessary.

While a present prohibition of navigation by deep draft commerical vessels within a zone near the reef to the degree consistent with international law might reduce the risk of groundings somewhat, the current risk appears to be small and the reduction that would be achieved by such a prohibition is uncertain. In view of the international complexities of the situation, before regulations are imposed, the need for such regulations must be more apparent.

International recognition of the Banks as a "area to be avoided" by vessels would enhance the protection of the Banks, by eliminating vessel traffic, the risk of groundings, and harm from any discharges which might occur despite the sanctuary regulations. The designation of areas to be avoided is a deliberate and lengthy process. The U.S. Coast Guard (the designated U.S. International Maritime Consultative Organization [IMCO] representative) must transmit documentation in support of the Banks' recognition to IMCO for review and ultimate approval by the IMCO Assembly, which meets only once every two years. While no sanctions are available to the coastal state for failure to abide by the international recognition, the area would be marked on navigational charts for use by ships' captains and it seems likely, given the small area and the possible dangers of transit near the shallow reefs, that international recognition would be most effective in reducing traffic and discharges. Since IMCO procedures permit the establishment of an "area to be avoided" by certain classes of vessels, the restrictions on sanctuary transit could, if appropriate, be particularly tailored to restrict only those vessels of sufficiently deep draft to ground on the Banks.

The IMCO recognition would avoid all jurisdictional complications and would avoid differential treatment of domestic and foreign vessels.

d. Fishing

The proposed Designation precludes any marine sanctuary regulation of fishing with minor exceptions.

Article 5. Relation to Other Regulatory Programs

Section 1. Fishing. The regulation of fishing is not authorized under Article 4 except with respect to the removal or deliberate damage of distinctive features (paragraph (a)), the use of certain techniques (paragraph (f)), or trawling on the banks (paragraph (g)). In addition, fishing vessels may be regulated with respect to discharges (paragraph (e)) and anchoring (paragraph (b)). All regulatory programs pertaining to fishing, including particularly Fishery Management Plans promulgated under the Fishery Conservation and Management Act of 1976, 16 U.S.C. 1801 et seq. shall remain in effect and all permits, licenses and other authorizations issued pursuant thereto shall be valid within the Sanctuary unless inconsistent with any regulation implementing Article 4.

The authority to regulate would be established only for those aspects of fishing operations which may threaten the coral reef and its ecosystem. Taking of coral and other marine invertebrates, plants and tropical fish would be prohibited under sanctuary regulations but an exception exists for takings which are incidental to other fishing operations. Fishing vessels would be subject to the regulation concerning anchoring and discharges which have been discussed above. Trawling within the 100 m isobaths is subject to marine sanctuary regulation and the proposed regulation would prohibit it. While the Designation does propose establishing sanctuary authority to regulate the use of spearguns, as well as the use of poisons, electric charges and explosives, no restrictions affecting spearfishing are contained in the preferred alternative.

There is no evidence, that any fishing operations or activities associated with them, other than those discussed above, could cause any harm to the sanctuary's resources. If any further regulation of fishing is required, OCZM will consult the Gulf of Mexico Fishery Management Council and request that it act.

Trawling within the 100 m isobath

§934.6(a)(4) Trawling within the 100 m isobaths.

No person shall trawl or drag bottom gear within the area of the Sanctuary defined by the 100 m (328 ft.) isobaths.

The proposed regulation prohibits the use of trawls and other bottom gear within the area of the sanctuary where such techniques could significantly disturb the reefal ecosystems. Trawling over or near the coral and other bottom formations creates an unacceptable risk of severe physical harm to these resources. In addition, the turbidity caused by bottom trawling, were it to occur within the 100 m isobaths, could adversely affect the corals in particular.

The economic impact of the regulation is minimal. Currently there are no shrimp or finfish trawl fisheries at the Banks. Even if such fisheries developed, fishermen are likely to avoid the Banks because the nets can be snagged and damaged. Except for the small area near the reef zone, defined by the 100 m isobath, trawling, like other fishing operations, cannot be regulated in the sanctuary.

Spearfishing

As noted above, the proposed Designation does include spearfishing as an activity subject to sanctuary regulations. However, the preferred marine sanctuary imposes no restraints on spearfishing at this time because the data are insufficient to demonstrate that spearfishing is threatening the health or stability of the reef ecosystem. The proposed

listing of spearfishing in Article 4 of the Designation would enable OCZM to propose regulation of spearfishing for public comment and possible adoption under the Administrative Procedure Act and National Environmental Policy Act without having to amend the Designation. In the absence of listing, the entire designation process would have to be repeated prior to any regulation.

This flexibility to respond to changing conditions appears important in regard to spearfishing. In the absence of future data demonstrating adverse impacts, no regulations will be proposed. However, if it is determined that increased spearfishing is harming the reefs or posing a danger to divers and other users, OCZM will have authority to propose regulations. Spearfishing may well increase with increasing recreational use of the Banks, particularly if designation of the sanctuary popularizes them. Thus, some increase in stress is possible within a short time and it is desirable to maintain the ability to respond to these problems.

e. Research

Important research at the Flower Garden banks may require certain activities that violate sanctuary regulations, such as the taking of coral, construction, or the discharge of chemicals. The preferred marine sanctuary imposes a permitting system in situations to allow valuable research which would otherwise be prohibited.

§934.9. Permit Procedures and Criteria.

a. Any person in possession of a valid permit issued by the Assistant Administrator in accordance with this section may conduct any activity in the Sanctuary including any activity specifically prohibited under section 934.6 if such activity is either (1) research related to the resources of the Sanctuary or (2) to further the educational value of the Sanctuary, or (3) for salvage or recovery operations.

The remaining subsections of 934.9 describe the procedures for applying for a permit and section 934.11 describes the system proposed for appeals concerning permits.

The permitting system would assist OCZM in evaluating the status of on-going research at the Banks and would form the basis for a data collection about the Banks resources. A major joint NOAA/EPA monitoring and research effort is foreseen at the Banks. The permitting system would assist in coordinating this public research with other efforts. The permitting system might also assist in the identification of data gaps and help avoid duplication of research efforts.

The permitting system, while it may impose some slight delay on research will assure that research does not harm the sanctuary resources. Where collection or use of chemicals is too extensive, for instance, the permits could be denied or modified. A central control over impacts from research activity would be established.

As discussed above, a draft Memorandum of Understanding concerning Federal jurisdiction over coral on the OCS is being developed by NOAA and BLM. The draft proposes transfer of permitting authority concerning coral

to OCZM upon designation of a marine sanctuary and the implementation of coral protection regulations. Thus, only a sanctuary permit would be required for research in the sanctuary which might affect the corals or associated organisms.

3. Alternatives to the Proposed Action and Environmental Impacts

In addition to the regulations proposed as the preferred alternative, various alternative regulations were considered. The impacts of each and a comparison with the proposed action are set out below.

a. Oil and Gas Activities - Alternatives to the Proposed Regulations

Two basic alternatives have thus far been analyzed - the status quo alternative and the preferred alternative. In addition, the following alternatives for regulating oil and gas activities were considered.

Option 1. Adopt draft EPA NPDES permit conditions as marine sanctuary regulations.

In response to the NOAA White Paper on the Flower Garden Banks, EPA submitted extensive comments and a draft set of conditions for the issuance of NPDES permits for oil and gas operations in the vicinity of the East and West Flower Garden Banks (U.S. Environmental Protection Agency, 1978b). OCZM considered incorporating the requirements suggested by EPA in the proposed sanctuary regulation of oil and gas activity.

The draft NPDES permit conditions provided that no NPDES permits would be issued for discharges from drilling facilities within 1.8 km (1 nm) of the 100 m (330 ft.) isobaths surrounding the Flower Garden Banks whether the leases pre or post dated the announcement of the policy. EPA also

proposed a five-year moritorium on the granting of NPDES permits for drilling discharges on leases awarded after October 1, 1978, within 11.1 km (6 nm) of the Bank mid-points. Existing leases within this area would be granted an NPDES permit, but the permit would require that the drilling effluent be shunted to 6 m (20 ft.) of the bottom. EPA's other conditions, specified below, also would apply to any permits issued for discharge in this area.

Both new and existing leases (as of October 1, 1978) located beyond 11.1 km (6 nm) but less than 16.7 (9 nm) from the Bank mid-points would be granted an NPDES permit provided that the drilling effluent was shunted to within 6 m (20 ft.) of the bottom and the additional conditions attained (see below). Beyond 16.7 km (9 nm) from the Bank mid-points, surface discharge of effluents would be allowed. The EPA conditions are pictured in Figure F-12.

EPA's additional permit conditions required that any discharges within the 16.7 km (9 nm) radius be accompanied by a comprehensive monitoring program based on minimum criteria to be developed by EPA. This monitoring program would be more extensive than that required by BLM. All drilling operations would be monitored before, during, and after the drilling of each well to provide information on the composition, direction, extent, and environmental effects of drilling discharges (U.S. Environmental Protection Agency, 1978b). The

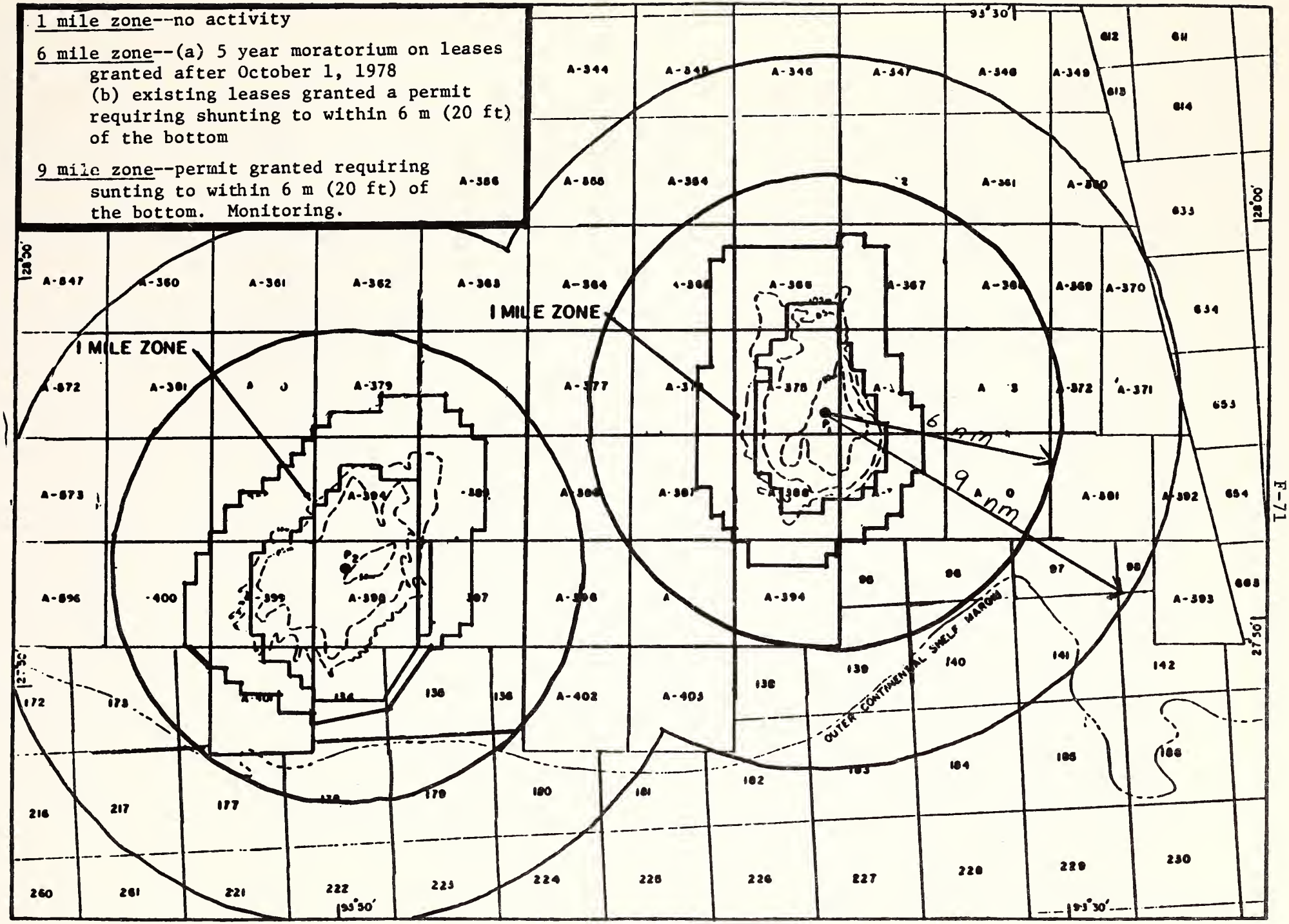


Figure F-12. Draft NPDES permit conditions proposed by EPA.

results of the monitoring program would be assessed by the EPA Region 6 Regional Administrator and evaluated in deciding, at the conclusion of a five year study period, whether to retain or modify the NPDES conditions, including the no discharge area.

EPA's draft proposed conditions would prohibit all bulk discharges of drill cuttings and fluids (i.e., those not screened out by properly operating shale shaker, desander, and desilter units) within the 16.7 km (9 nm) radius. EPA also would: (1) prohibit the discharge of oil-based drilling effluents; (2) limit cooling water discharges to a total residual chloride concentration of 0.2 mg/1 daily average or 0.5 mg/1 daily maximum; (3) require that sanitary wastes be given biological treatment followed by disinfections with a chlorine residual of 1 mg/1 before discharge; (4) require that deck drainage discharges not exceed 30 mg/1 daily average or 50 mg/1 daily maximum for total suspended solids and 48 mg/1 daily average or 72 mg/1 daily maximum for oil and grease; and (5) require that no sanitary or domestic waste, or deck drainage may contain any constituents which exceed applicable marine water quality criteria after allowance for initial mixing (U.S. Environmental Protection Agency 1978b).

This option differs from the preferred alternative as follows:

(a) Boundary. The preferred boundary is 4 nm from the 100 m contour, which is approximately 6 nm from the Banks' mid-points. Refer to Figure F-7.

EPA's original draft permit conditions contained 3 boundaries extending from the Banks' mid-points within which different levels of restriction would be placed on oil and gas operations. See Figure F-12.

(1) No NPDES permits would be issued within 1 nm of the 100 m isobath. (For the impact of this proposal on Mobil Oil Corporation's plans to develop tract A-389 at the East Flower Garden Bank, see below.)

(2) A 5-year moritorium on the issuance of NPDES permits for leases awarded after October 1, 1978, would be placed in effect within 6 nm of the Banks' mid-points.

(3) Existing leases from 1 nm to 6 nm from the mid-points and new and existing leases, as of October 1, 1978, located between 6 nm and 9 nm from the Banks' mid-points, could be granted an NPDES permit providing the following conditions would be met:

- o Drill effluents would be shunted to within 6 m of the bottom;
- o The effluent guidelines in Table F-3 would apply;
- o All discharges would be monitored;
- o Bulk discharges and the discharge of oil-based muds would be prohibited; and
- o Miscellaneous discharges such as cooling waters, sanitary wastes and deck drainage would be subject to the limitations specified above.

TABLE F-3 EPA Effluent Guidelines and Standards for Far Offshore* Oil and Gas Extraction Facilities (40 CFR Part 435).

Effluent Limitations

Oil and Grease

Pollutant parameter waste source	Maximum for any 1 d, milligram per liter	Average of daily values for 30 consecutive days shall not exceed, milligram per liter	Residual Chlorine, minimum for any 1 d, milligram per liter
Produced Water----	72	48	NA
Deck Drainage-----	72	48	NA
Drilling muds-----	(1)	(1)	NA
Drill cuttings----	(1)	(1)	NA
Well treatment----	(1)	(1)	NA
Sanitary:			2
M10---------- [3]	NA	NA	1
M9IM---------- [3]	NA	NA	NA
Domestic ---------	NA	NA	NA
Produced sand-----	(1)	(1)	NA

1/ No discharge of free oil

2/ Minimum of 1 mg/1 and maintained as close to this concentration as possible.

3/ There shall be no floating solids as a result of the discharge of these wastes.

NOTE: M10 means facilities continuously manned by ten (10) or more persons. M9IM means facilities continously manned by nine (9) or less persons or intermittently manned by any number of persons.

*Beyond 3 nm.

(b) No activity zone. The no activity zone under the preferred alternative is the 85 m contour delineated by BLM stipulation in the quarter-quarter-quarter system except where the 100 m isobath extends outside this boundary. In these places, the area within the 100 m isobath is included in the no activity zone. The original proposal of EPA was for a "no-activity" zone within 1 nm from the 100 m isobath. In this zone, no NPDES permits would be granted.

(c) Shunting. The preferred alternative requires shunting to within 6 m of the bottom within 4 nm of the 100 m isobath.

The orginal proposal of EPA would have required shunting within the zone from 1 nm from the 100 m isobath to 9 nm from the Banks' mid-points.

(d) Monitoring. The preferred alternative requires monitoring of all discharges within 4 nm of the 100 m isobath. The original EPA proposal would have required monitoring within 9 nm of the mid-points.

(e) Other provisions. The preferred alternative includes the provision that operators who want to discharge in the sanctuary must first obtain a valid NPDES permit. This would make the operators subject to the effluent limitations specified above.

The major difference between the preferred alternative and adopting EPA's original permit conditions is that the area of restriction is reduced. Under the original EPA proposal, larger areas would have been established as buffer zones between oil and gas operations and the Banks.

The non-issuance of NPDES permits within 1 nm of the 100 m isobath would have affected the operations on 6 leased tracts. At the East Flower Garden Bank tract A-365 (Sun Oil), A-389 (Mobil Oil), tract A-367 (American Natural Gas) and tract A-376 (Texaco) would be affected. At the West Flower Garden Bank tract A-379 (Mobil) and tract A-384 (Union Oil of California) would be affected. Tract A-384 (Union Oil of California) lies entirely within 1 nm from the 100 m isobath and, hence, a no discharge condition would effectively preclude drilling in the tract. Mobil, on tract A-379, would be affected by this no-discharge zone as would Sun on A-365, Texaco on A-376, American Natural Gas on A-367 and Mobil on A-389.

The Mobil A-389 tract is the only tract for which a development and production plan has been submitted to the U.S. Geological Survey for approval. The Mobil plan calls for a platform to be set in 425 feet of water just outside the BLM stipulation "no activity" zone. EPA's proposed no discharge condition would have forced Mobil to relocate its platform an additional mile from the Bank, to a site 1 nm outside the 100 m contour in keeping with EPA's proposed no discharge zone. This would impose additional costs of $3 million (over the original $17 million) for platform redesign and delay. Furthermore, Mobil projected it would not be able to reach all the reserves because of the additional horizontal distance and angle which would have to be drilled. Since relocation would force the loss of one half of the expected resource recovery, Mobil projected that the total sum which would have to be invested to recover the resource ($63 million) would make the resource no longer economically feasible to recover (Mobil Oil, 1978a; Kreuz, 1978, personal communication).

The preferred alternative, i.e. adopting a smaller no activity zone closely aligned with BLM's, avoided imposing these substantial costs on existing leases. In addition, the agreement between NOAA and EPA which coordinates proposed marine sanctuary regulations and NPDES permit conditions gives operators on these existing leases predictability concerning the discharge requirements which the two agencies will impose. The agencies will act consistently and operators can rely upon the essentially uniform requirements.

Adoption of this alternative would have included larger buffer areas against potential adverse effects from drilling effluents, oil spills, blowouts, or other oil and gas related activities. This alternative is considerably more cautious than the preferred alternative in terms of exposing the reefs to possible impacts from oil and gas related pollution.

This alternative would have imposed significant restraints on oil and gas operations in an area extending 9 nm from the Banks mid-points. The preferred sanctuary alternative, while conforming to some of the requirements in this alternative, confines the no-activity zone to a smaller area thus avoids significant impacts on existing leases which would have been affected by the no-discharge zone, and limits all other regulations to an area 4 nm from the 100 m isobath (somewhat less than 6 nm from the Banks' mid-points) instead of to 9 nm from the mid-points. The preferred alternative moratorium on oil and gas operations on leases issued after the effective date of the sanctuary regulations is approximately comparable in its geographic extent to the moratorium proposed in this alternative.

The proposed 9 nm boundary of this option affects all or part of 90 tracts -- 34 of which have been leased and one which is being offered in OCS lease sale No. 58A. Total bonuses paid at lease sales for the 34 leased tracts amount to approximately 450 million (U.S. Geological Survey, 1978b). Within the 16.7 km (9 nm) radius, 65 wells have been drilled on the 34 blocks and two platforms (which are not producing) have been installed. An additional platform has been ordered for tract A-389, at the East Flower Garden Banks, and is scheduled for installation in March 1980 (U.S. Geological Survey, 1978b).

Option 1 was not chosen as the preferred alternative because, even though it is more environmentally restrictive than the preferred alternative, it imposes an extremely high cost on oil and gas operators.

Option 2. Various individual restrictions in operations. A variety of possible regulations of oil and gas activities were also considered.

(a) Retain the no activity zone stipulated by the Bureau of Land Management at the 85 m isobath in the quarter-quarter-quarter designation.

The option differs from the preferred alternative in that the no activity area was extended to include those areas where the 100-m isobath extends beyond the 85 m quarter-quarter-quarter designation. The BLM no activity area does not provide protection from 85 to 100 m over the hardbank, habitat for various organisms of the reef ecosystem, particularly crinoids. See Figure F-13.

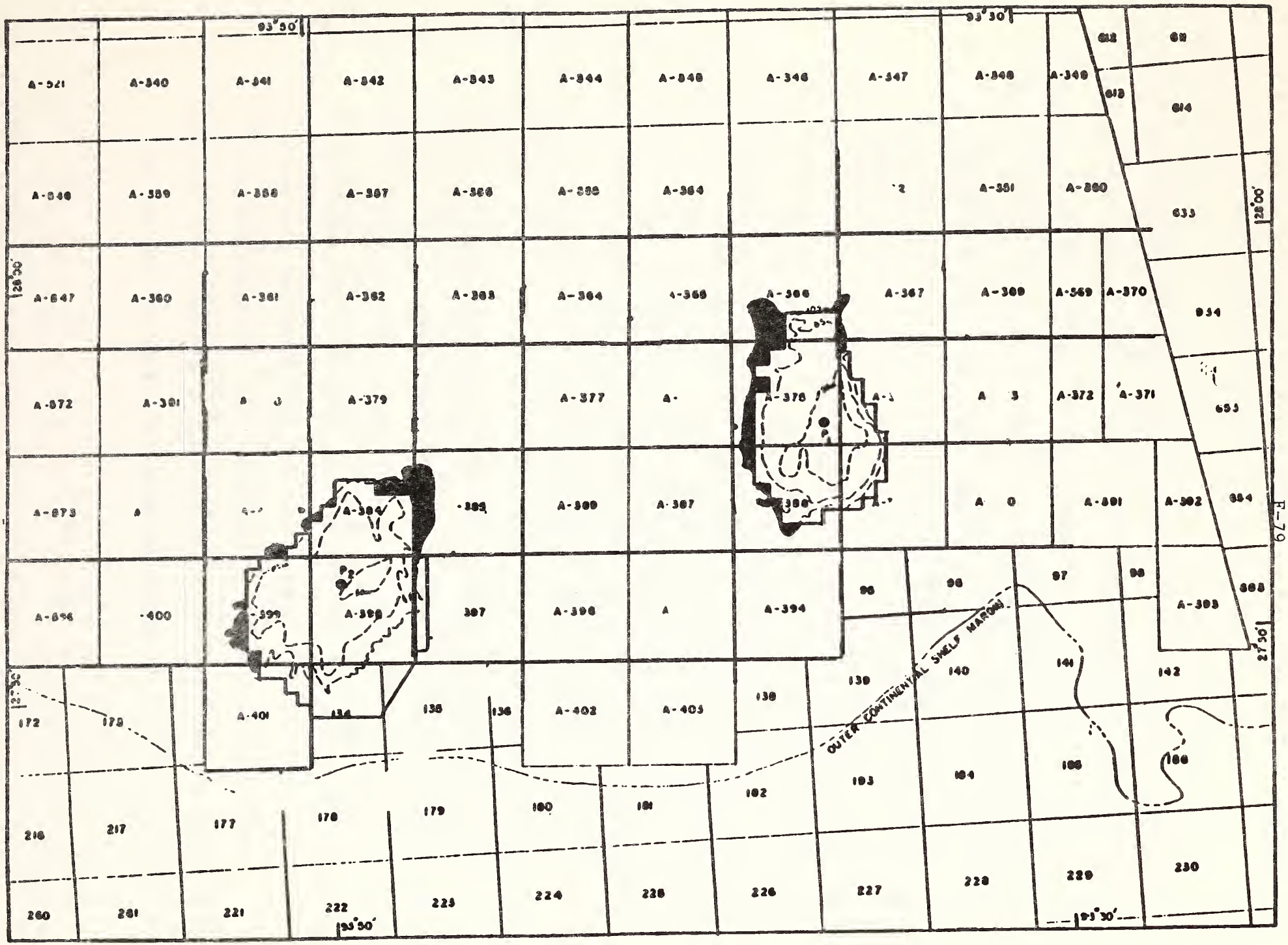


Figure F-13: Comparison of NOAA's no activity zone with BLM's

Drilling, construction, or related oil and gas development activities within the 85 m isobath are prohibited preventing direct physical damage resulting from pipeline construction or platform implacement activities to part of the hard bank. The prohibition zone combined with shunting into deep waters (as specified below) provides a buffer area to protect some Bank communities from burial by sediments and possible pollutants discharged from a drilling platform located beyond the prohibition zone. The buffer is smaller and less protective than that of Option 1, but was considered adequate, with minor extension described in the preferred alternative, to protect the Banks from the impacts of activities on existing leases very near the Banks. Since there are no activities occuring in this zone now because of BLM stipulation, and a similar prohibition area has been included in stipulations for all leasing to date, existing drilling operations would not be affected.

(b) Shunting and monitoring of drilling discharge effluents to 3 nm from 85 m isobath and shunting to 10 m from bottom.

A shunting and monitoring zone extending only 3 nm from the 85 m isobath, rather than the proposed 4 nm from the 100 m isobath was considered. This option was not chosen because the smaller area would not provide as much protection as the larger area. Evidence indicates that visible plumes from surface and mid water discharges travel distances greater than 2 miles. To double the margin of safety for the reef by

requiring shunting and monitoring to 4 nm is quite appropriate. Likewise shunting to within 10 meters of the bottom does not necessarily ensure that the disposed materials will be deposited in the nepheloid layer. For these reasons, the more strict preferred alternative was chosen.

(c) Impose no moratorium on oil and gas operations on prospective leases.

The alternative of imposing no moratorium on oil and gas operations on future leases was evaluated. This option would not have imposed sanctuary moratorium on operations on future leases but would have allowed the proposed NPDES conditions, including a moratorium on issuance of permits, to be enforced by EPA. Imposition of a moratorium will ensure that the risk of potential harm to the reefs will not increase from operations on new leases until the nature of the threats is more fully understood. It will allow five years for NOAA and EPA to conduct a comprehensive research effort to try to determine the impacts of oil and gas development on the Banks and to devise protective measures more attuned to the minimum level of regulation necessary to protect the living resources.

NOAA chose, as its preferred alternative, to impose a moratorium on new leases in order to control the level of development at the Banks while the necessary studies are being conducted. The impacts of the moratorium are discussed above under the preferred alternative.

Option 3. A larger sanctuary to include a surface discharge monitoring zone 1 nm beyond the proposed present sanctuary boundary of 4 nm from the 100 m isobath.

In this option, a monitoring zone extending 1 nm beyond the boundaries of the preferred alternative was considered. The zone would have allowed evaluation of the impacts of surface disposal of drilling effluents in this area. The monitoring zone dimension was intended to supplement the preferred alternative by expanding the area in which monitoring of discharges of drilling effluents would be required. No other requirements would have been imposed on operations in this area. The additional cost for the operators would have been the $300,000 - $500,000 cost of each monitoring program.

Option 4. Prohibition of oil and gas development within the sanctuary.

This option would prohibit all oil and gas development within the marine sanctuary boundary. There are presently no production wells within this area, although a production platform is planned by Mobil Oil Corporation for A-389 at East Flower Garden Bank. The total cost of bonus bids for these tracts which would be affected by the prohibition was $164,774,970. (See Table F-4.) This total figure would be

higher if converted to 1978 dollars. While not this entire investment would be lost, the economic impact of such a restriction is clearly very significant, and raises questions concerning required compensation to lessees.

TABLE F-4. Cost of Existing Leases within the Sanctuary.

WEST FLOWER GARDEN BANK			EAST FLOWER GARDEN BANK		
A-384	$3,579,000	(2/76)*	A-395	$ 327,999	(4/78)
A-370	$6,230,000	(5/74)	A-367	$ 3,222,000	(7/77)
A-382	$3,222,000	(5/74)	A-352	$ 2,318,000	(2/76)
	$13,031,000		A-376	$45,887,000	(5/76)
			A-365	$36,999,993	(5/74)
			A-389	$24,912,000	(5/74)
			A-368	$38,077,977	(6/73)
				$151,743,970	

Total costs of existing leasing within the Sanctuary is $164,774,970

*Figure in parenthesis represents month and year of sale.

b. Recreation - Alternatives to the Proposed Regulations

Besides the status quo alternative and the preferred alternative, the following options were considered in relation to regulating recreational activities.

Boat Anchoring

Option 1. Prohibit all anchoring over the live reef areas.

OCZM evaluated the option prohibiting all recreational boat anchoring in waters shallower than 50 meters (164 ft.), the live coral zones. Recreational boat anchoring any place else on the Banks could occur unrestricted. This option is environmentally the most protective since it would assure that no anchor damage could occur to the corals.

However a prohibition on anchoring on the reef areas of the Banks would effectively eliminate recreational diving because, for safety reasons, the dive boat must be anchored securely at the dive site. Some recreational diving at the reef margins might be possible with a dive boat anchored just off the reef, but the greater depths in this area (100-150 ft.) would discourage most divers. Recreational hook and line fishing would also be restricted. The restrictions of this option were determined to be too severe.

Option 2. Require all anchoring at buoys.

OCZM considered requiring that all boats moor at buoys placed near each Bank. These buoys would be securely anchored in sand flat areas to avoid damage to corals, but would be located within safe diving distance of underwater reef outcrops or features of diving and/or fishing interest. Recreational boats would be required to use these moorings whenever stopping over the reef. If, during heavy use periods, all buoys were occupied, anchoring could be allowed in sand flat areas using appropriate procedures described in the preferred alternative. Each buoy would be designed to accommodate up to three recreational boats.

This option was not chosen because of the excessive economic and environmental cost compared to the preferred alternative. Private suppliers estimate a lighted five-foot mooring buoy designed to accommodate three recreational boats would cost about $6,000 to $7,000. If a boat is supplied to emplace the buoy, the emplacement cost would be about $600 and the yearly maintenance cost (again if a boat is provided) would be an additional $600 (Automatic Power, 1978, personal communication). A permit for a private aid to navigation would be required from the U.S. Coast Guard. USCG estimates of costs are considerably higher.

The emplacement of a mooring buoy would allow continued and enhanced use by recreational divers and fishermen, as well as reduce the need for recreational boat anchoring on the live reef area. A significant decrease

in future anchor damage on the reefs and its associated impacts might occur. By placing buoys near the more spectacular and interesting reef features, recreational visitors would be assured of the most enjoyable experience possible. The presence of these buoys would also better mark the reef areas for both navigation in general and surveillance by sanctuary enforcement officers. The convenience of marking features of recreational interest and providing secure easily used mooring stations would serve to encourage increased recreational use of the reefs and enhance the region's overall marine recreational opportunities.

The most significant adverse impact caused by mooring buoys is the increase and concentration of recreational use at particular points on the reef. Recreational ativity will be concentrated at these areas, as well as the associated impacts of littering, souvenir collecting and physical damage from handling coral formations. Even though prohibited, such damage will undoubtedly occur. Further, the mooring buoys themselves could inflict significant physical damage to the reef if they are not set or rigged properly. The mooring cable and anchor block of the buoy could scrape or crush the coral if it is allowed to directly contact living coral or if heavy seas were to move the buoy.

The presence of mooring facilities could encourage the exploitation of reef resources by non-recreational users. Commercial collectors of marine organisms and objects could more easily locate the reefs. A

number of means of reducing adverse effects might be available. Where severe impacts are encountered and reported by the monitoring program, buoys could be removed from the reef entirely. Alternatively, buoys could be raised periodically (perhaps on an annual or bi-annual basis) and relocated elsewhere on the reef. In this way, impacts could be spread more evenly over the reef and, at the same time, afford regular visitors a greater diversity of experiences. A third method of avoiding a concentrated recreational impact would be to encourage use of buoys on a rotational basis. This could be accomplished by rotating markers on the buoys that indicate if it is available for use at a particular time.

A potentially significant problem with mooring buoys is vandalism. Since the Coast Guard would require the buoy to be lighted, vandals could either steal or break the light thereby incurring added replacement and maintenance costs. Under a worse case situation, vandals could set the buoy adrift or even steal it. Incidents such as these have been reported to the U.S. Coast Guard's district office in New Orleans (Harrison, 1978, personal communication).

Spearfishing

Option 1. Restrict spearfishing in the sanctuary.

This option would impose certain restrictions on the extent of spearfishing activity but would not prohibit it. It would establish a mix of some or all of the following types of restrictions: (1) limiting the types of species that could be speared, (2) limiting the size of fish taken, (3) limiting the number of fish that could be taken, (4) limiting the season for spearfishing at the sanctuary,

(5) limiting the type of gear, and (6) limiting the areas where spearfishing could occur.

Species for which spearfishing could reasonably be prohibited are the resident fish and crustaceans including parrot fish, jewfish, some snappers, nurse sharks, trigger fish, hinds, lobsters, and the smaller reef fish such as damsel fish, butterfly fish, squirrelfish. No restrictions need be imposed on other more migratory game species such as sharks, bluefish, tuna, amberjacks, jacks, dolphin fish, red snappers, runners, and barracuda. This restriction recognizes the widespread abundance of highly migratory species of game fish while also recognizing the more precarious situation of resident species. Protection of the reef resident species protects the reef ecosystem and decreases the risk that their population levels will be reduced to a point where they may be eliminated from the reef. If eliminated from the reef, their repopulation would be unlikely since the nearest recruitment sources (other reef systems) lie several hundred miles away.

Restriction on size limits could include a prohibition on spearing any fish less than two feet in length. Although the two-foot limitation is somewhat arbitrary, the age required to reach this length would insure that harvested fish would be mature animals having had the opportunity to reproduce. Certain resident reef species, such as the jewfish, might need a larger minimal size since their recruitment rate would likely be slower. The two-foot limitation also protects the smaller tropical reef fishes.

A limitation on the number of fish that could be taken might be established at three fish per diver per reef visit. This type of restriction helps reduce and limit the extent of spearfishing impacts by limiting the level of harvesting pressure. A seasonal limit -- perhaps June through September -- would permit spearfishing during peak use seasons and would insure that a significant portion of the year was set aside for rebuilding depleted populations. The selection of a season, however, requires an analysis of game fish breeding seasons. This information is currently not available and would have to be developed by research studies at the reef. Gear restrictions would prohibit the use of any self-propelled or automatic spear guns. By limiting spearfishing to hand-held spears, spearfishing pressure could be reduced. An area limit such as restricting spearfishing to one of the two Banks might be imposed. This could insure that the non-spearfished bank would retain a population for recruitment of the fished bank.

At the present time, the absence of detailed site specific information concerning the extent of spearfishing activity, the effects of the sport on the reefal system, and the abundance and habits of target species make it impossible to select an appropriate mix of the above management techniques. Any regulations adopting one or a combination of these rectrictions would reduce spearfishing pressure and thereby reduce the potential of adverse impacts from the sport. Although

implementation of restrictive regulations for spearfishing could reduce the numbers of spearfishers at the sanctuary the regional effect would be insignificant since many other spearfishing areas (such as other banks or around OCS oil and gas platforms) abound in the western Gulf of Mexico.

Option 2. Prohibit spearfishing within the sanctuary

Under this approach, sanctuary regulation would prohibit spearfishing activity within the sanctuary boundaries. The rationale is based on: (1) the potential reduction of a predatory species and the resulting effect this might have on the reefal system; (2) the potential reduction of the abundance of large reef fishes and creation of a fear response in fish to the presence of divers; (3) the ample availability of other more convenient spearfishing locations on the other banks or possibly around drilling platforms; and (4) the probable increase in spearfishing activity should the site be "advertised" by sanctuary designation. The selection of this option would provide a maximum level of protection for reef resources from any potential threats of spearfishing and would help preserve the coral reef ecosystem intact at the Banks.

Prohibiting spearfishing in the sanctuary appears to be more stringent than currently necessary to protect the reef and would unnecessarily restrict the activities of recreational divers. Hard

evidence does not exist to verify the concern that spearfishing has caused or is causing an impact on the Bank's species abundance or reefal ecology. The 110-mile distance from shore is an imposing barrier for most recreational divers and may be an effective deterrent to intense spearfishing activity.

Souvenir/Specimen/Tropical Fish Collecting

Option 1. Restrict souvenir/specimen/tropical fish collecting.

This option would prohibit the collection of all but a few specifically identified living and non-living reef resources whose limited removal would cause no possible damage to the overall quality of the Bank's living community or non-living resources. For example, some living resources may be abundant both on and around the Flower Garden Banks. Rapid recruitment from surrounding areas could make the limited removal of these species by recreational divers of only negligible significance. This option, therefore, would exempt from a general collecting prohibition those species of mollusks, fish, or crustaceans whose limited removal is acceptable sanctuary use.

With the present state of knowledge concerning the Bank biota, abundance, and general ecology, it is impossible to develop this list of exceptions. A listing of exempted species would require a delay for necessary research. Because of the slow coral growth rate and its importance as marine habitat, no exemption for the collection of any corals would be provided.

This option would combine a level of resource protection and a limited reduction in recreational activity on the sanctuary reefs, although the delay in creating the list would allow collection to continue unregulated. The restrictions placed on souvenir collecting could discourage some potential recreational divers from visiting the reefs; the visually dramatic underwater seascape is likely to overcome this reservation. This restriction would not be expected to diminish the level of recreational use at the Banks.

c. Commercial Shipping - Alternatives to the Proposed Regulations

Three options in addition to the status quo and preferred alternatives were considered.

Option 1. Discharge of wastes: Seek status as IMCO area to be avoided.

Under this alternative, no regulations would be imposed, but instead OCZM would seek international recognition of the Banks as an IMCO area to be avoided which would reduce the pollution potential by reducing the number of vessels that transit the area. This differs from the preferred alternative in that the preferred alternative includes the imposition of regulations prohibiting discharges to the degree consistent with international law. Status as an area to be avoided is a supplement to the preferred alternative. This option

was not selected because the prohibition on discharges provides a significant measure of environmental protection at virtually no additional cost to shipping, while international recognition in conjunction with regulations will provide maximum protection. During the time period that must elapse prior to IMCO recognition, about 2 years, harm from vessel discharges should be prevented to the fullest extent practicable.

Option 2. Prohibiting anchoring within the Sanctuary.

In addition to the preferred alternative of prohibiting anchoring by commercial vessels within the 100 meter isobath, OCZM evaluated the additional alternative of prohibiting anchoring by commercial vessels anywhere within the proposed sanctuary to the extent consistent with international law.

Prohibiting anchoring by commerical vessels anywhere in the sanctuary would fully protect both the live coral formations and the remainder of the hard banks from all forms of anchor and anchor chain damage. The prohibition would exempt OCS supply vessels anchoring outside the 100 m isobath to support OCS operations.

It is difficult, in the absence of data to indicate that anchoring off the Banks would be harmful, to propose a total prohibition on anchoring. The reported problem of tankers anchoring near the Bank for tank cleaning prompted consideration of this alternative. Since the preferred alter-

native prohibits discharges in the sanctuary, this no anchoring alternative would be unduly restrictive and duplicate protection provided by other sanctuary regulations.

Option 3. Prohibiting commercial vessel traffic within the sanctuary to the extent consistent with international law.

Prohibiting commercial vessel traffic where the vessels could strike the reefs (fishing boats, charter recreational boats, and OCS supply vessels generally would not) would reduce the risk of groundings except for the risk of groundings by vessels which are unaware of their location or unable to alter it. These latter risks are not currently quantifiable. The reduction in risk depends upon the size of the "safety zone" around the actual reef.

The complexity of establishing the dimensions of such safety zone and the present lack of hard data on the level of risk posed by deep draft vessels mitigate against such regulation. The reduction of the risk of groundings achieved by such a prohibition cannot be specified, but the harm that could result from even one grounding is significant. While prohibition would tend to lower that risk, and the costs imposed on shippers to avoid the sanctuary would be minimal, in view of the international complexities, the need for additional sanctuary regulations must be more apparent. The recognition of the sanctuary through IMCO procedures as an area to be avoided was selected as a more reasonable way to contain threats from vessel traffic.

d. Fishing - Alternatives to the Proposed Regulations

Option. Prohibit commercial fishing on the reefs.

Besides the preferred alternative, which precludes any regulation of commerical fishing, except for very limited matters, one additional option was considered, that of prohibiting commercial fishing on the reef caps. At least three factors dictated against such an alternative. First, the Fishery Management Council retains ample regulatory authority to control fishing activities on the reefs if that becomes necessary. Second, there is no demonstrated damage being done to the reefs by commercial fishing; and third, the Flower Garden Banks support only a modest snapper and grouper fishery that should not be unnecessarily hampered.

Option 1. Prohibit recreational fishing within 50 m isobaths.

Two additional alternatives were evaluated. The first would prohibit recreational fishing within the 50-meter isobath of both Banks. Such a regulation would preserve the coral zone biota in its present state, unstressed by recreational fishing pressures. The fish living in conjunction with the live coral and forming an integral link in the coral and reef food cycles would be protected.

Although the probability of recreational harvests affecting the fish populations is low, some pressures might be exerted upon the reef system, unless the area were closed to fishing. In addition to reducing the take, this option would incidentally reduce the number of vessels over the live reef cap to those involved in other recreational activities. The result would be reduced harm to the reef from both physical and ecological stresses.

Sport fishing, an important recreational activity, would be banned from the live coral zone of the two banks. Since recreational use is one major factor and value to be preserved, the restriction counters part of the purpose of designating the site a marine sanctuary. In addition, the Gulf Fishery Management Council is fully capable of responding to any demonstrated need for the closure of fishing.

Option 2. Prohibit recreational fishing on one reef on a rotating basis.

The other alternative considered would prohibit recreational fishing on one reef at a time. This option would represent a middle ground between a prohibition status and a no-regulation status. One reef would remain available for sport fishing while the other would be closed within the 50-meter isobath. The decision on which Bank should be restricted involves several factors -- proportionately more research has been completed on West Flower Garden Bank and the vast majority of all recreational fishing occurs on the shallower East Bank (Blood, 1978, personal communication). It was suggested, therefore, that the West Bank be closed initially but that ongoing research programs at the site assess the feasibility of alternating closures between the two Banks. For this restriction to be effectively implemented, this option would have to have been coordinated with alternative spear-fishing, souvenir/specimen collecting, and research regulation.

The closure of one reef to sport fishing would tend to preserve the natural ecosystem at the closed reef. With one reef open, recreational fishing would be preempted form only one live coral cap. West

Flower Garden Bank, the restricted reef, would become a control site to contrast the impacts of recreational fishing upon East Flower Garden Bank. Comparative studies at each Bank could supply data on the actual impacts of sport fishing on the reef system.

By limiting fishing at one reef, the other reef would be subject to increased fishing pressure, promoting alteration of the reefal ecosystem at an accelerated pace. Also, concentrated fishing activity on one reef could create problems with other recreational uses. Heavy sport fishing at East Flower Garden Bank could make sport diving unsafe, increase littering, or increase anchor damage.

No current data supported any closure to recreational fishing anywhere in the sanctuary. Recreational use of the reefs should be preserved in the absence of a compelling need to impose restrictions. Finally if restrictions are required they should be developed by the Gulf Fishery Management Council whose statutory mandate and expertise qualify it for such undertakings.

e. Research - Alternatives to the Proposed Regulations

No alternatives were considered other than the status quo and the preferred marine sanctuary alternative.

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APPENDIX 1: Brief Review of the Outer Continental Shelf (OCS) Oil and Gas Development Process

In virtually all instances, the pattern of OCS oil and gas development follows the same basic steps: 1) pre-exploration, 2) leasing, 3) exploratory drilling, 4) development drilling, 5) production, and 6) completion. During pre-exploration activity, oil companies send research vessels to conduct seismic surveys of an area to determine the geologic structure and location of potential petroleum bearing strata. Since OCS lands are federally owned, oil companies must first secure the right to drill and exploit the natural resources before any drillings can be conducted. Drilling rights on the OCS are obtained by leasing areas (called blocks or tracts) from the responsible federal agent -- the Bureau of Land Management (BLM). The oil companies nominate for lease sale those tracts which they view as promising and bid on those tracts in a competitive bid lease sale. BLM reviews the highest bids and may accept or reject them. If the high bids are deemed commensurate with the resource potential, the company is granted a lease to drill and develop the block. For the Flower Garden Banks area, the tracts which have already been leased as well as the tracts which will be up for bid in the near future are shown in the text on Figure E-5.

Upon award of a lease, exploratory drilling from a drilling "rig" may be conducted to determine the precise location, extent, and quantity of oil and gas resources. This involves drilling an average of about four exploratory wells per tract from a movable, temporary rig. If an exploratory well indicates the presence of petroleum hydrocarbons, additional wells are drilled to determine the areal extent of the reservoir(s) and to aid in locating the

optimal site for production platforms (U. S. Department of the Interior, 1976) Tracts on which exploratory drilling has occurred are shown in the text on Figure E-5. After exploration is complete, but before commercial production can begin, a development plan must be prepared by the developer and submitted for approval to the U. S. Geological Survey (USGS). The USGS reviews this plan to insure that safety and environmental standards are met. In addition to those blocks which have production facilities in place, development plans have been submitted for tracts A-389, A-596, A-355, and A-356 in the Flower Garden Banks area.

After approval of the development plan, production "platforms" are installed on the tract and development wells are drilled. A tract with a high resource potential might include two platforms and approximately 40 wells. Based on development to date, a more realistic figure for the number of wells per tract near the Flower Garden Banks would be 15 to 20 (U. S. Geological Survey, 1978). Production "platforms" are more permanent structures than drilling "rigs" since they must serve throughout the production life of the field (which may be 15 to 40 years) and withstand the rigors of even the most severe ocean storms. In addition to platforms, production facilities normally include transportation systems to shore (usually pipelines in the Gulf of Mexico) and onshore processing and storage plants.

After all recoverable oil and gas resources have been exploited, the well is closed below the sea floor and the platform and pipelines are removed.

APPENDIX 2 Chemical and Physical Effects of Drilling Effluent Discharges

This appendix discusses the chemical and physical effects of the discharge of drilling effluents (muds and cuttings) on the resources of the Flower Garden Banks.

--Chemical Effects

To date a principal concern relative to toxic effects of drilling chemicals has centered on the effect of chlorinated bactericides -- specifically pentachlorophenate which is added to muds to retard hydrogen sulfide production. Robichaux (1975) has indicated upon review of the literature that this bactericide can be particularly persistent and hazardous to marine oganisms and birds if discharged into the sea. As a result of this concern, the use of halogenated phenol bactericides has been prohibited as an OCS drilling additive within BLM's Flower Garden Banks' stipulation zones (Adams, 1978, personal communication).

The principal chemical components of drill muds are bentonite and barite (barium sulfate)(see Table 2-1). Due to the large amounts of barium discharged in drill effluents, concern has been expressed for the potential effect of barium on marine organisms. The U. S. Environmental Protection Agency (1978a,b), in its proposed permit conditions for NPDES permits at the Flower Garden Banks, cites two papers which indicate that barium bioaccumulation is a significant natural phenomenon in phytoplankton and zooplankton (Lowman et al. 1971), as well as fish (Templeton, 1958). While these studies do not attempt to demonstrate the possible toxic effects of abnormally high barium levels, such as around drill rigs, their findings do indicate the need for further research -- particularly on potentially sensitive life forms such as zooplankton.

A recent study of barium (Tagatz and Tobia, in press) concludes that "...although it (barium) appears to be relatively non-toxic to many organisms, barium in large amounts as discharged in offshore drilling could adversely affect the colonization of various substrata by benthic organisms." Although these results were attained in a laboratory using barium concentrations over 200 times higher than those occurring from drilling discharges, the effect on adult organisms does indicate a sensitivity in the marine biota tested. Because larval or juvenile life stages are typically more sensitive to chemical pollutants in general, there is a reasonable concern that concentrations of barium approaching those resulting from drilling discharges could create a significant impact on marine life forms which bioaccumulate barium -- particularly during immature life stages. Investigations of such possibilities have not been conducted and are needed.

Studies that have been conducted on the toxicity of drill muds have been reviewed by the Sheen Technical Committee (1976) and are summarized in Table 2-2. Although these studies indicate that barium in exceedingly high concentrations is not toxic to the species tested, and thus provide a marginal level of confidence in the environmental safety of the drilling effluent, it is impossible to extrapolate these findings to other marine biota. Generally, the species tested are notably hardy species which are not found at the Flower Garden Reefs. These studies, like those cited in the previous paragraph, fail to address the impact on the most sensitive life stages of organisms inhabiting the Flower Garden Bank, and further support the need for additional research.

TABLE 2-1. TYPICAL MUD COMPOSITION - SEAWATER GEL MUD (Otteman, 1976)

This type of mud is typically used to drill from the base of the conductor casing to the surface casing point. Generally, the seawater gel system will be used from less than 1000 feet to a maximum of 4500 feet. The components used to make up and maintain the required characteristics of this mud system are:

Mud Components	Lbs/Bbl of Mud
1. Drilled Solids	48-60
2. Bentonitic Clay	30-40
3. Caustic - Sodium Hydroxide	0.5-1.5
4. Mica Flakes (Lost Circulation Material)	0.0- .5
5. Cellulose Polymer	0.0-.25
6. Seawater	As required - approx. 10#/bbl salt from the seawater

LIGHTLY TREATED LIGNOSULFONATE SEAWATER/FRESHWATER (6,000-8,000 ppm Cl^-)MUD

As the hole is deepened below surface casing it becomes necessary to start adding additional materials to maintain the desired mud characteristics. Slowly freshwater is substituted for seawater as the depth and temperature increase. A typical 10.0-10.5 pound per gallow lightly treated lignosulfonate system used to about 10,000 feet would include:

Mud Components	Lbs/Bbl of Mud
1. Drilled Solids	55-70
2. Bentonitic Clay	20-30
3. Barium Sulfate - Weight Material	45-60
4. Caustic - Sodium Hydroxide	1.0-2.0
5. Lignosulfonate	4-6
6. Lignite	0.0-3.0
7. Cellulose Polymer	0.0-.25
8. Seawater/Freshwater	As required - approx. 5# bbl salt from 50/50 seawater-freshwater

LIGNOSULFONATE FRESHWATER (3,000-4,000 ppm Cl^-)MUD

The deep portion of a typical well (below approximately 10,000 ft) would require a freshwater lignosulfonate mud system in order to maintain the mud properties as desired for proper hole maintenance. A typical 10.0-11.0 pound per gallon lignosulfonate treated mud system would include:

Mud Components	Lbs/Bbl of Mud
1. Drilled Solids	65-80
2. Bentonitic	20-30
3. Barium Sulfate - Weight Material	55-150
4. Caustic Sodium Hydroxide	1-2
5. Lignosulfonate	4-8
6. Lignite	3-8
7. Defoamer/Detergents	0.5
8. Freshwater	As required

TABLE 2-2. Acute Toxicity Bioassays on Drilling Mud Materials (Sheen Technical Committee, 1976).

Material	Aqueous Test Medium	Test Animal	96-hr TL_{50}* ppm	Reference
Barite	Sea water	Various marine animals	>7,500	Daugherty (1951)
	Fresh water	Sailfin mollies	>100,000	Grantham & Sloan (1975)
	Sea water	Sailfin mollies	>100,000	Grantham & Sloan (1975)
Bentonite	Fresh water	Rainbow trout	>10,000	Logan, Sprague and Hicks (1973)
	Fresh water	Gambusia	>100,000	Wallen (1951)
Calcium carbonate	Fresh water	Sailfin mollies	>100,000	Grantham & Sloan (1975)
	Sea water	Sailfin mollies	>100,000	Grantham & Sloan (1975)
Ferrochrome lignosulfonates (Q Broxin, Peltex, and Spersene)	Fresh water	Rainbow trout	1,530	Logan, Sprague and Hicks (1973)
Chrome lignosulfonate	Fresh water	Sailfin mollies	7,800	Hollingsworth & Lockhart (1975)
	Sea water	Sailfin mollies	12,200	Hollingsworth & Lockhart (1975)
	Galveston Bay sea water	White Shrimp	465	Chesser & McKenzie (1975)
Iron lignosulfonate	Galveston Bay sea water	White Shrimp	2,100	Chesser & McKenzie (1975)
Lignite	Fresh water	Sailfin mollies	24,500	Hollingsworth & Lockhart (1975)
	Sea water	Sailfin mollies	>15,000*	Hollingsworth & Lockhart (1975)
Caustic soda (NaOH)	Fresh water	Rainbow trout	105	Logan, Sprague and Hicks (1973)
Potassium chrome aluminum [$KCR(SO_4)_2 \cdot 12\ H_2O$]	Fresh water	Rainbow trout	730	Logan, Sprague and Hicks (1973)
Sodium acid pyrophosphate	Fresh water	Rainbow trout	870	Logan, Sprague and Hicks (1973)
	Fresh water	Sailfin mollies	1,200	Hollingsworth & Lockhart (1975)
	Sea water	Sailfin mollies	7,100	Hollingsworth & Lockhart (1975)

*Actually, 100% survival of all test animals. (This is the solubility limit of the chemical in sea water.)

The effects of chromium in chromelignosulfonate (CL) drill muds is another potential concern. CL muds are used to control viscosity in holes deeper than 700 m (2,500 ft) and may be used in concentrations of 44,600 ppm (Sheen Technical Comittee, 1976). The EPA has determined a safe limit for chromium in the marine environment to be 50 ppb (U. S. Environmental Protection Agency, 1976a). Although the discharge of CL muds may create at least a localized water quality impact, the Sheen Technical Committee (1976) asserts that chromium ions are strongly bound to the mud clays. Moreover, the Offshore Operators Committee (1978) indicates that any free chromium ions would be rapidly dispersed to acceptable levels within 100 m (330 ft) of the drill pipe outfall.

The effects of whole lignosulfonate-type drill muds on corals were studied by Thompson and Bright (1977) in laboratory tests. Although their methods involved direct application of highly concentrated muds (1 part mud to 1 part water) to corals -- a situation which would not occur in drilling discharges -- the tests did cause substantial mortalities in test animals. The Offshore Operators Committee (1978) states that the concentrations used in this study far exceeded those which would occur in real world situations.

Last, numerous field studies designed to determine the fate of drilling effluents discharged into the sea have been conducted for the Bureau of Land Management and various oil companies. Ecomar (1978), in one of the few reports analyzing the fate of aqueous ionic constituents, reported that concentrations of barium, chromium, and lead in the water column dissipated to background levels within 100 to 100 m (330-660 ft) of the discharge point. Most of the other studies concentrate attention on the accumulation of drilling constituents in sediments surrounding various drill sites. For instance, Continental Shelf Associates (1976) indicated a fourfold increase in barium levels within 500 m

(1 650 ft) of a surface water discharging drilling operation, with a slight but distinct increase at a distance of 1,000 m (3,300 ft). Similarly SUSIO (1976) found increases in barium levels throughout its 1,000 m (3,300 ft) radius sampling area.

Several similar monitoring studies have occurred in the Flower Garden Banks area. Marine Technical Consulting Services's 1976 study of Union Oil Company's shunted well on block A-384 indicated that increases in barium levels in sediment were limited to areas within 300 m (990 ft) of the drilling site. The study also included observations of the West Flower Garden Bank's coral reef community before, during, and after drilling and identified no signs of stress reactions that could be related to discharges. A similar sutdy was conducted by Continental Shelf Associates (1978) for Mobil Oil Corporation's exploratory wells 3 and 4 on block A-389. The results of their sediment analyses for barium indicates a 293% increase in barium levels 1,00 m (3,300 ft) southeast of the drilling site, which indicates that the shunted drilling fluids were distributed distances exceeding 1 000 m (3,300 ft). Evidence of dispersal to the coral reefs -- which are located 2,000 m (6,600 ft) northwest of the drill site and in waters roughly 70 m (several hundred feet) shallower than the shunt pipe, was not, however, detected.

In summary, in reviewing the available information on chemical toxicity, there is no hard evidence that significant impacts (either short- or long-term) will result from the disposal of drilling effluents. Evidence from studies of the toxicity of drilling muds on freshwater and estuarine species is not, however, necessarily transferrable to the Flower Garden Banks situation. On-site evidence from the monitoring studies conducted to date indicates that the limited drilling which has occurred near the reefs has produced no visible (in the literal sense) impacts on the behavior of reefal organisms or measurable impacts on the

reefs' water quality. Reef monitoring efforts, however, have relied primarily on sight observations with only minimal use of bioassay and chemical analysis.

--Sedimentation Effects

In addition to the chemical effects of discharged drill muds and cuttings, suspended particles can have a significant impact on marine biota. The Bureau of Land Management (1977) estimates that a 3,000 m (10,000 ft) well generates 900 metric tons (995 tons) of drilling muds and 238 cubic meters (311 cubic yards) of cuttings. While some of the drilling muds are salvaged for use in future drilling operations, a large quantity of material must be disposed. Historically, this material has been dumped at the sea surface below the drilling platform. Coarser and denser materials settle rapidly to the sea floor immediately beneath the platform while the finer materials are transported away in a visible plume. The potential effects of this suspended particulate matter on the reefal community are discussed below.

Corals are susceptible to both the indirect effects and the direct effects of sediments (Bright and Jaap, unpublished). In terms of indirect effects, even small amounts of sediments suspended in the water column serve to reduce the amount and depth of light penetration and, hence, reduce photosynthetic activity by symbiotically-associated zoozanthellae algae. This reduction in ambient light levels, in turn, inhibits the productivity and growth of living corals (Aller and Dodge, 1978; DiSalvo and Odum, 1978; Bak, 1978; and Graus and MacIntyre, 1978). Because the maximum depth for reef building corals is often limited by the depth to which adequate levels of light can penetrate, if light levels are reduced even slightly for a prolonged period of time, corals and algae at the lower levels of the reef might be killed or damaged.

If sediment settles and accumulates on their surfaces, corals can be smothered. Although corals can sweep small amounts of falling sediments from their surface by combining the excretion of mucus with ciliary movement, large amounts cannot be removed. This process also imposes an energy demand on corals, which is particularly costly if accompanied by reduced light levels and the attendant reduction of photosynthetic activity of the coral's food-producing symbiotic zooanthellae algae. The energy lost in the sweeping process will reduce the productivity of the corals since it would otherwise be allocated to growth, reproduction, or possible disease resistance. Since coral reefs typically operate on a tight biological energy budget, any energy drain can be accommodated for short periods of time and consequently, persistent or long-term sedimentation can destroy the living corals. Any long-term stress -- even though minor -- could be particularly severe at the Flower Garden Banks since these reefs are already stressed by their location at the northern extreme of the distribution of coral reefs in the Gulf of Mexico.

In the worst case, heavy sedimentation would simply bury and suffocate most species, so that only the most mobile of the reef-associated species could survive. Survivors would include most fishes and crustaceans and some of the mobile worms and cephalopods. Attached and less mobile species would probably fail, including all coral, algae, bryozoans sponges, hydroids, and most echinoderms and mollusks. The more mobile species would be driven from the haven of the reef where they would be exposed to rapid predation. In the absence of a continuing food resource, many of the mobile predators would move on and the "reef community" would be largely dead. It would be subsequently reinvaded by the soft-bottom species, but in the absence of hard substrates, the corals would not return. Even if hard substrates remained, reinvasion and reestablishment of the myriad of normal reef inhabitants from Mexico and the West Indies would probably require

thousands of years because of the remoteness from other reefal organism stocks.

In summary on-site monitoring studies conducted in association with shunted exploratory wells around the East and West Flower Garden Banks have found no observable stress or impact on the coral reef communities (Marine Technical Consulting Services, 1976; Continental Shelf Associates, 1976 and 1978; and Bright and Rezak, 1976 and 1978). The low level of shunted drilling activity thus far appears acceptable; however, a concentration of drilling activity within a limited area could raise ambient suspended sediment levels to a cumulatively significant and damaging level. Further, current patterns in different locations relative to the reef could produce results different from those cited above.

Evidence already cited indicates that deep water discharges of drilling effluents around the Flower Garden Banks can result in sediment movement beyond 1,000 m (3,300 ft) from the discharge point (Continental Shelf Associates, 1978, and Marine Technical Consulting Services, 1976). A pre-drilling monitoring report prepared in conjunction with Mobil's exploratory drilling on tract A-389 also indicates that there is a potential upwelling current around the Banks (Continental Shelf Associates, 1976). If bottom currents carry drilling effluent to this upwelling current, drilling effluents could be transported at diluted levels to the live reef areas. McGrail (1978, personal communication), however, strongly discounts the potential for currents to carry sediment up to the reefal level and asserts that, even if it were to occur, suspended sediments would be advected away from the reef. Monitoring studies to date support this position.

APPENDIX 3: NOAA/EPA PRINCIPLES OF AGREEMENT
Coordination of Regulations and Permits for Flower Garden Banks

The following represents a joint statement of policy by the NOAA/EPA Interagency Committee for Program Coordination:

(1) In carrying out their respective responsibilities under Section 402 of the Clean Water Act (CWA) and under Section 302 of the Marine Protection, Research, and Sanctuaries Act (MPRSA), EPA and NOAA agree that, to the maximum extent practicable, they will establish consistent conditions governing oil and gas activities in the proposed Flower Garden Banks Marine Sanctuary (Sanctuary). The conditions agreed upon are attached.

(2) EPA shall issue guidance to the Regional Administrator of Region VI for the development of permit conditions under Section 402 of the CWA for discharges from oil and gas activities within the waters proposed as the Sanctuary, which guidance shall be consisent with the attached conditions to the maximum extent practicable.

(3) NOAA's proposed regulations under Section 302 of the MPRSA relating to discharges from oil and gas activities in the Sanctuary, shall be consistent with the conditions agreed upon with EPA.

James P. Walsh
Deputy Administrator
National Oceanic and
Atmospheric Administration

3/14/79
Date

Thomas C. Jorling
Assistant Administrator for
Water and Waste Management
Environmental Protection Agency

3/13/79
Date

Flower Garden Marine Sanctuary Regulations and Permit Conditions

A. Sanctuary Boundary: 4 nautical miles from the 100-meter isobaths.

B. No Activity Zone: either: within 85-meter isobaths as defined by quarter-quarter system; or, 100-meter isobaths, whichever is farther from the Banks' midpoints.

C. Conditions for Allowing Operations: No oil or gas operations will be allowed in the sanctuary until a National Pollutant Discharge Elimination System (NPDES) permit has been issued.

1. Shunting of cuttings and adhering drilling muds: to within 6 meters of the seabed within sanctuary defined above.

2. Monitoring: all leases within the sanctuary defined above.

3. Monitoring Requirements: once before, frequently during and once after drilling, with parameters, timing, and other requirements as specified in NPDES permit. Such specifications shall in general be agreed upon by NOAA and EPA.

4. Bulk Discharge of Muds: prohibited within sanctuary defined above.

5. Contingency Plans (for spills of oil and hazardous materials, and for procedures to be followed if Regional Administrator imposes a "no-discharge" permit condition.): required as specified in NPDES permit and sanctuary regulations and agreed upon by NOAA and EPA.

6. Other Discharges - Produced water, Deck drainage, Cooling waters, and Sanitary wastes: in compliance with NPDES permit conditions.

7. Non-Simultaneous Drilling and Discharge (sequential drilling of and discharge from one well at a time from a single platform): required in sanctuary with provision for reconsideration via the conditions of an NPDES permit.

D. Five-Year Moratorium: Five-year moratorium on operations on unsold leases and future leasing within 4 nautical miles of the 100 meter isobaths.

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